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Canada

An Analytical Model for Assessing the Costs and Benefits of Training and Utilizing Auxiliary Health Personnel with Application to the Canadian Dental Therapy Program

R. Gordon Trueblood

A Thesis

in

The Department

of

Educational Technology

Presented in Partial Fulfillment of the Requirements
for the Degree of Doctor of Philosophy at
Concordia University
Montréal, Québec, Canada

April 1992

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ABSTRACT

An Analytical Model for Assessing the Costs and Benefits of Training and Utilizing Auxiliary Health Personnel with Application to the Canadian Dental Therapy Program

R. Gordon Trueblood, Ph.D.
Concordia University, 1992

The foremost inducement for the training and utilization of auxiliary health personnel is that they are expected to increase the amount and effectiveness of work done within the health care system by reaching previously under-served people with important basic services at low cost. The objectives of this study were to develop an analytical model capable of assessing the costs and benefits of the training and utilization of auxiliary health personnel and to apply the model to the Dental Therapy Program of Health and Welfare Canada. Dental therapists are operating dental auxiliary personnel of non-native and native ancestry trained for two years in therapeutic and preventive dentistry to provide basic dental care services in Indian and northern communities of Canada.

The major research question guiding the present study was: from the perspective of Health and Welfare Canada, what are the costs involved in the training and utilization of dental therapists to provide basic dental services in Indian and northern communities and how does this compare with the results obtained? The investigation was conducted in three separate but interrelated phases: (1) the economic analysis of the program, (2) an assessment of the quality of care provided by dental therapists,

and (3) a study of the predisposition and attitudes of dental therapists toward their jobs. The investigation was carried out using four different study groups.

Using an *ex post facto* intracohort trend study of 32 dental therapists who graduated between 1984 and 1987, the economic analysis arrived at a positive net present value for the cohort. The quality of care investigation was carried out for the following reasons: when using the market value of outputs produced by professional practitioners to establish the market value of auxiliary produced outputs, it is essential to establish that the latter outputs have the same clinical effects as the former, and to ensure that effort had not been lost by auxiliaries in providing services repetitively and inappropriately. The quality of clinical care and the quality of community care were found to be commendatory. The attitude study revealed dental therapists are satisfied with their jobs and their salary. However, an important conflict was found between dental therapists' desire for job security and a better career structure and the intention of Health and Welfare Canada to provide front line dental health personnel in Indian and northern communities.

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My greatest personal gratitude I save for last. To Norman (Naim) Bou Khalifé I offer my gratitude for his continuous support and almost irrational patience during the years of study. In the nearer term I thank him for the encouragement and many hours of coaching and prodding, and for knowing, even when I did not, that the job would be completed. Also, to Tiki, who is always there for me, I offer my gratitude.

DEDICATION

This study is dedicated to my mother and father:

Myrtle E. Stallings Trueblood Gibbs

John Wesley Trueblood, III

My mother is always a source of encouragement. She taught me the success of perseverance. My father instilled in me a love of learning. I know he would approve.

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CHAPTER I

INTRODUCTION

In times of rising costs and increasing economic restraints, corporate managers tend to regard human resources development as an expense to be minimized, as a cost which yields no immediate returns to the firm, hence dispensable. On the other hand, human capital theorists view corporate education and training as an investment in the productive capabilities of employees to influence future monetary returns to the firm. An investment, by definition, incurs costs and is expected to yield benefits.

Cost-benefit analysis is a method of investment appraisal. Cost-benefit analysis of employee training has become one of the most important issues of the decade for business and industry. Managers typically demand efficiency and accountability and subsequently require evidence that the results obtained from employee training are commensurate to the resources consumed. The bottom line is that the benefits derived from employee training must be at least equal to the investment or training should not be funded by the employer.

The use of cost-benefit analysis of employee training extends equally to training in the health industry. The past three or four decades have seen a proliferation of training programs for auxiliary health personnel as the concept has spread from technically less developed areas to more industrialized countries. The generally advanced rationale for the production of auxiliary health personnel is relief of the shortage of professional health personnel. Auxiliary health personnel are expected to provide important basic services to the consumer at low cost to the provider (health

agency). Although consumers will benefit from increased availability of services, what is the evidence that the gains flowing from the training and utilization of auxiliary health personnel also accrue to the provider who frequently finances the costs of training?

Background and Justification

The training and utilization of all categories of health personnel have received considerable attention by governments, institutions, and professional associations. Over the past three or four decades the training and utilization of auxiliary health personnel have become increasingly important as governments struggle with the paradox of lowering the cost of health care delivery while responding to demographic changes and increasing public expectation for equity in health care (Berman, Gwatkin, & Burger, 1986; Storms, 1979; WHO/UNICEF, 1978; WHO, 1979). Many countries have made the commitment to "go to scale" with training programs aimed at producing one or more of a variety of auxiliary personnel (Berman et al., 1986).

Although the vital role of auxiliaries in the health care system has long been recognized (WHO, 1977), with the spiralling cost of health care delivery and the increased interest of all governments in investigating the most efficient means to improve health, it is inevitable that low cost alternative methods of delivering health services must also be cost accountable and will, subsequently, come under close scrutiny (Mills, 1985b; Niessen & Douglass, 1984; Warner, 1989; Warner & Luce, 1982). As government funds become scarcer, policy may dictate that government

sponsored training programs for alternative providers of health care will have to demonstrate high public and/or private utility (Anderson & Kasl, 1982). Anderson and Kasl also write that the ultimate concern for [government sponsored] training programs should be "efficiency in obtaining results commensurate to the resources consumed" (p.229). Today, limited government resources have resulted in cost benefit analysis occupying a secure position in the armamentarium of decision-making techniques at the disposal of the health services (Dinkel, 1985; Dunlop, 1975; Warner, 1989; Warner & Luce, 1982).

This need for cost accountability was recognized by the World Health Organization and the United Nations Children's Fund at the Alma Ata conference in 1978 where a new approach to health services delivery was proclaimed and endorsed by 134 governments. This approach, called primary health care (PHC), was described as comprising:

> Essential health care made universally accessible to individuals and families in the community by means acceptable to them through their full participation and at a cost that the community and country can afford. (WHO/UNICEF 1978, p.2)

This definition in addition to putting emphasis on the organization and delivery of health services, also emphasizes the importance of cost efficiency in the delivery of health services. Since dentistry is one of the components of health care, implicit in the term "essential health care" is "essential dental health care".

There have been a variety of cost benefit studies dealing with the education (institutional training) of professional health manpower (Cohen, 1985; Dunlop, 1975). On the other hand, direct measurement of training and utilization costs and program

benefits of national scale auxiliary health worker programs has generally been given poor and inconsistent attention in the available literature (Berman et al., 1986). The present study supports the emphasis on essential health care at costs affordable to the community and the country by analyzing the differences between the total training and operational costs of Canadian dental therapists on the one hand and the cash value of services produced by the same dental therapists on the other hand.

Problem Development

The spiralling cost of health care has received global attention. In Canada, with its universal health care system, including the Federal government's Non-Insured Health Benefits Program for status Indians and Inuit, the magnitude of health expenditures is increasingly worrisome for health care policymakers and analysts. The Non-Insured Health Benefits Program pays on behalf of status Indians and Inuit the cost of certain health-related goods and services not covered by provincial or territorial health insurance plans or programs, or through other forms of third-party coverage (Health and Welfare Canada, 1989). The Non-Insured Health Benefits Program covers claims for prescription drugs, medical supplies and equipment, optometric services and eye glasses, dental care, and medical transportation.

Since 1979 when the Non-Insured Health Benefits program was implemented, expenditures for eligible benefits have increased from actual expenditures of $36 million to $312.8 million in fiscal year 1990/91, or an 869 per cent increase (Health and Welfare Canada, 1991). During the same time period costs to the Federal

Government for dental services for eligible Indians and Inuit have escalated from $6.4 million to $74.5 million, or a 1,158 per cent increase. There is nothing to indicate that this trend will fall in the foreseeable future. A contributing factor to rising dental costs is the number of private dental practitioners practicing in the system. The costs attributable to dental practitioners are not only their remuneration but also a sum in excess of that amount reflecting other expenditures which result from their professional services. Another important multiplier contributing to increasing costs of dental care will be the number of Indian people who will be reinstated to Indian Status as a result of Bill C-31.

Related to the problem of spiralling cost of health care and increased client demand are problems of availability, accessibility, and acceptability of health manpower (Berman et al., 1986; Cohen, 1976). In Canada, although significant improvements in the dentist-to-population ratio have been made over the last twenty years, the dentist-to-population ratio is still relatively poor in comparison with other nations (WHO, 1989).

The low dentist-to-population ratio is an indicator of the availability of dental services to the population. There are also geographical disparities not only between provinces but within the provinces (Chebib, 1973; Health and Welfare Canada, 1990) which affect the accessibility of dental services by those in need. The poorer provinces and rural communities suffer from limited dental services. Among the most profoundly affected are Indian and Inuit communities. Most Indian and Inuit communities are typically rural, having small populations located in isolated areas

where health facilities are scarce (Health and Welfare Canada, 1984). The remoteness tends to hinder health development. Transportation, delivery of supplies and services become costly and difficult. Thus many native communities have suffered from impaired accessibility to primary health care, including dental care.

With increasing interest in controlling health expenditures on the one hand and improving the accessibility to essential health services by large numbers of previously under-served people on the other hand, internationally there has been a proliferation of training programs for auxiliary health personnel trained to a defined level of competency to perform a limited range of diagnostic, preventive, and therapeutic services under limited supervision (Berman et al., 1986; Djukanovic & Mach, 1975; Flahault & Roemer, 1986; Storms, 1979; WHO, 1979). In 1974 Canada introduced a new type of dental auxiliary, the dental therapist, patterned after the New Zealand dental nurse model but dramatically altered and expanded to fit the needs of small, isolated Canadian communities, particularly in the north. Dental therapists undergo two years of formal training at the National School of Dental Therapy in basic dental care treatment. Students are taught to administer local anaesthetics, prepare cavities and place routine dental restorations including filling material, pins and crowns, and extract uncomplicated teeth as prescribed. Dental therapists are also trained to take dental radiographs in order to facilitate the examination that will be made by dentists. All training costs are paid by the Federal Government. The costs include tuition fees, books, uniforms, and dental equipment. Following successful completion of training, employment is offered to graduates by the Federal Public Service (Medical Services

Branch, Health and Welfare Canada) to serve the status Indians, Inuit and all persons resident in the northern Territories (National School of Dental Therapy, 1989).

The foremost inducement to the training and utilization of auxiliary health personnel is that they are expected to improve the cost-effectiveness of the health care delivery system by reaching large numbers of previously under-served people with important basic services at low cost (Berman et al., 1986; Storms, 1979; Walsh & Warren, 1979; WHO, 1978; WHO, 1979). A major point of contention are the figures which go into making up the "low cost". Where training and employment of auxiliaries are entirely paid by the Federal Government, as in the case of the Canadian dental therapists, the full costs of their training and employment are imputed in the "low cost".

It is but a short intellectual hop from the Federal Government's training and employment of dental therapists to Becker's concept of Human Capital Theory. Human capital theory as proposed by Becker (1962) is a conceptual framework for viewing investments in learning and the anticipated economic returns. Becker explains this phenomenon by distinguishing between general and specific training. Perfectly general training, writes Becker, is paid by the individual and is training that would be equally useful in many firms and marginal products would rise by the same extent in all of them. Nursing education and teacher education are examples of perfectly general training. Completely specific training "is training which is provided entirely by the firm and which increases the productivity of the trainee in the firm providing the training but does not raise the worker's productivity in other firms" (Ziderman,

1978).

The Federal Government's investment in the training and employment of dental therapists is a paradigm case of human capital investment. Training of dental therapists is provided entirely by the Federal Government. Since dental therapists are only authorized to work under the auspices of the Federal Government (Health and Welfare Canada) and its representatives (Government of the Northwest Territories), employment following training is available only with the Federal Government and its representatives. Therefore, the acquired knowledge and skills of dental therapists are not transportable to outside firms.

The resources consumed in the training and employment of dental therapists are thought to be commensurate with the results obtained on the job. This emphasis on results obtained being commensurate with resources consumed, inherent in Human Capital Theory, begs the question of cost benefit analysis as a method of investment appraisal.

In the past it was generally assumed *a priori* that all auxiliary health worker programs were cost beneficial. In recent years questions have been raised concerning their cost accountability (Berman et al., 1986). In a study on policy and practice in national community health worker programs in four countries on four continents, Gilson (1990) reports that "insufficient attention was paid to the financial and resource implications of programmes..." (p. 85). With this in mind, it must also be remembered that funding agencies, whether governments or international agencies, are becoming increasingly interested in accountability for their funds disbursements. They want to

verify that the actual investment of monies into the training and utilization of auxiliary health personnel conforms with the original intention of greater coverage at low cost (Austin, 1978).

Although there are several cost-effectiveness studies of small-scale auxiliary health worker pilot projects, absent from the available literature is any kind of costs and consequences studies of the training and utilization of auxiliaries on a national scale (Austin, 1978; Berman et al., 1986). The literature acknowledges that small-scale pilot training and utilization projects are usually judged successful because they are invariably implemented under ideal conditions and carefully guided and monitored to demonstrate effectiveness (Berman et al., 1986). Large-scale training and utilization programs do not enjoy the same degree of intensive and flexible support. Subsequently, their cost and consequences may be expected to be quite different.

Administrators are traditionally interested in efficiency in obtaining results commensurate with resources consumed. Yet, the appeal for economic accountability for training and development activities is long on demand but short on responses. In 1980 Tosti wrote that organizations "typically fail to analyze [the] purposes, costs or effectiveness [of training expenditures]" (p.4). In a 1984 article concerned with forecasting the economic benefits of training, Swanson and Geroy reported that their literature review uncovered large voids in the economic analysis of training. In 1985 Drucker reiterated the same concern: that very few corporations "...have any idea what they are getting for all the money and effort they spend on training, let alone what they should be getting" (p.30). In the same year Cohen wrote that "while cost-benefit

analysis of institutional training is fairly widespread, systematic cost-benefit studies of company training are scarce" (p. 327). Finally, in 1990, Carnevale and Schulz had this to say about economic accountability for training:

> Despite the growing demand for accountability, financial accounting for training shows only a slight increase. As a rule, although training and development are undergoing more financial analysis, they are accounted for less than any other major corporate investment. (Carnevale and Schulz, 1990, p. S-2).

In 1979 Rees and Jutai produced an unpublished analysis of the hypothetical costs and benefits of training and employing Canadian dental therapists in Indian and northern communities. An estimative approach was used to assess program benefits. According to these researchers, taking into account all costs of training and employment and the annual dollar value of services provided by dental therapists, based on an accepted minimum level of 100% productivity, a dental therapist position would pay for itself in 2.2 years.

In summary, by the late 1960s the demands for dental care which confronted Health and Welfare Canada out stripped the resources available for coping with them. This chronic disparity between dental needs and resources led to the decision to train and utilize dental therapists. The aim of the dental therapist program is to reach large numbers of previously under-served Indian and Inuit communities with essential dental care at low cost. Although a plausible theoretical model has been presented which demonstrates obtainable results commensurate with the resources consumed within 2.2 years, Health and Welfare Canada still has no empirical evidence of the economic returns generated for all of the dollars put into the training and utilization of dental

therapists.

Problem Statement

The rising costs and increased client demands, together with continued fiscal restraint, have challenged the development of programs to meet the health needs of Canada's aboriginal people. This problem is not unique to Canada but common to all countries of the world having under-served populations. The proliferation of programs for the training and utilization of auxiliary health personnel has been predicated on the need to relieve the shortage of professional health personnel. Auxiliary health personnel are expected to provide important basic health services to the consumer at low cost to the government. Although consumers will benefit from increased availability of services, it has been suggested that governments have little evidence of the gains which flow from the training and utilization of auxiliary health personnel. Using a strict economic criterion, the benefits to the provider (health agency) in terms of increased revenues and/or cost avoidance should be commensurate with the resources consumed in training and employing auxiliaries.

Purpose and Objectives of the Study

The primary purpose of this study is to identify and reveal through a retrospective cost benefit analysis the accumulated costs and consequences to Health and Welfare Canada for training and utilizing dental therapists, and to determine if the training and utilization of dental therapists results in a net cost or benefit to Health and Welfare

Canada. This not only serves as a means for determining the merit and worth of the dental therapy program but will also generate information needed to determine the amount of effort needed to ensure Health and Welfare Canada will get the best value for its money. The study also provides information needed for assessing priorities for resources to be allocated to the program (Drummond & Stoddart, 1985). Since there is a causal link between the period of service provided by dental therapists and the dollar benefits (cost savings) which accrue to Health and Welfare Canada, the secondary purpose of the study is to assess dental therapists' attitudes toward their job. The objectives of the study are to:

1. Develop a cost-consequences model for examining the costs and benefits of training and utilizing auxiliary health personnel to provide basic health care to previously under-served populations.

2. Apply the model to the dental therapy program of Health and Welfare Canada to see if the program accrues an overall cost or benefit to the department.

3. Determine the predisposition and sentiments of dental therapists towards their work experience as a predictor of the likelihood of subsequent early separation.

Research Questions

The major research question guiding the present study is: From the viewpoint of Health and Welfare Canada, what are the costs involved in the training and utilization of dental therapists to provide basic dental care and treatment in Indian and northern communities and how does this compare with the results obtained? The problem is one of establishing a relationship between training and utilization effectiveness (the

ability of the system to achieve its objective) and economic effectiveness (cost of achieving the objectives). A secondary purpose is to consider additional factors related to economic effectiveness.

To answer these questions the study developed the investigation into three interrelated phases related to training and service delivery. The first phase of the investigation focused on evaluating the efficiency of the dental therapy program in obtaining results commensurate to the resources consumed in the training and utilization of dental therapists. This phase of the study investigated the following research question:

1. How does the productivity value of dental therapists services compare with the costs of training and employment?

The second phase focuses on the assessment of the quality of dental care provided by dental therapists included in the study. This stage of the study is considered essential in establishing the merit and worth of the program for the following reasons: (a) when comparing the market value of auxiliary produced outputs with the market value of outputs produced by professional practitioners, it is essential to establish that such outputs have the same clinical effect; (b) quality of care begins with the quality of the trainees recruited from the pool of qualified applicants and continues by providing appropriate training by qualified staff; (c) acceptable levels of quality of care ensure that effort has not been lost in providing services repetitively and inappropriately, resulting in possibly inflated productivity figures leading to a false positive outcome; and (d) quality of care is the best step to maintain the interest and support of the client population and the public that supports the program with its tax-dollars.

This phase of the study investigated the following research question:

2. How adequate is the level and quality of care provided by dental therapists trained and employed by Health and Welfare Canada?

    a. How does the level and quality of care provided by dental therapists compare with the level and quality of care provided by dental practitioners in achieving the same service objectives in the same population?

    b. Do dental therapists have the required supplies and equipment to adequately perform their duties as trained?

    c. How have dental therapists contributed to the quality of community dental health?

    d. To what extent has continuing education contributed to dental therapists' competence?

Phase three of the study investigated attitudinal factors which are believed to be associated with the period of service which a dental therapist will provide. The extent to which dental therapists' productive activity contributes to their aspirations and self-fulfillment will have a measured effect on the ability of Health and Welfare Canada to recoup the costs of training and employing dental therapists. This phase of the study investigated the following research question:

3. What is the relationship between dental therapists' demographic variables and dental therapists' predisposition and sentiments toward their work experience?

Significance of the Study

National health planners face the task of formulating national health plans, setting priorities, and allocating resources. Resources are extremely scarce, relative to need.

According to Wong'ombe (1984), the expansion of primary health care to under-served areas has not previously been the subject of cost-benefit analysis. Since Health and Welfare Canada directly finances the cost of training and employment of dental therapists, it would be particularly interested in the benefits gained from training and employment investments in the dental therapist approach relative to investment in other sectors. The knowledge gained from this study will provide policy analysts, health planners, and health economists with information needed to determine the amount of effort needed to ensure Health and Welfare Canada will get the best value for its dollar and ultimately to assess priorities for resources to be allocated to the program.

Although resources for the dental therapist program in Canada come from national sources, it must be remembered that in many developing countries international funding has played an important role in the emergence of auxiliary health workers. The funding agencies are more and more interested in accountability for their funds disbursements (Austin, 1978). They want to be able to verify that the actual investment of monies in auxiliary health worker projects, including training programs, conforms with the original intention. It is not inconceivable that linked to this would also be decisions concerning the continuance and level of program funding. The present study provides a flexible model for cost-benefit analysis of the training and utilization of auxiliary personnel.

The literature search for empirical or evaluation studies of the costs and consequences of training and utilization of auxiliary health personnel in general and dental

therapists in particular did not yield a significant amount of useful information. This observation is consistent with that of Berman et al. (1986) in their study of cost effectiveness of community health workers. The on-line data search for cost-benefit studies in manpower training revealed a substantial amount of current literature on methodological considerations and a proportional absence of applied studies. This void in the literature is also documented by Hawthorne (1987) and Swanson and Geroy (1984). Cohen (1985), Drucker (1985), and Tosti (1980) also confirm that systematic cost-benefit studies of company training are absent in the literature. This study is expected to add to the research literature on the economics of human resources development, particularly as it relates to training and utilization of auxiliary health personnel, as well as make a useful contribution to current literature related to cost-benefit analysis of employee training.

The application of cost and consequences techniques to dental health care has a much shorter history than in medical health care (Warner, 1989). Nevertheless, cost benefit studies in dentistry are becoming increasingly popular to compare community as well as clinical effectiveness. The field of public health dentistry has demonstrated a particular interest in cost and consequences of preventive agents and procedures (Horowitz & Heifetz, 1979; Warner, 1989). This study is expected to add to the available dental literature on community care.

Cost-benefit analysis may be grouped into two major approaches: prospective (*a priori*) and retrospective (*ex post facto*) (Cain & Robinson, 1969; McBride, Bertran, & Fernandez, 1987). The prospective approach is a program planning and budgeting

technique for predicting future costs and effects of proposed alternatives. By holding constant either the costs or the outputs in the equation, one can predict future costs and consequences. Since a prospective cost benefit analysis cannot predict with any accuracy market behaviour and cannot account for unforeseen circumstances, it is conducted assuming normal (i.e., ideal) conditions. This means that many important future events are not yet known or understood and therefore cannot be accounted for in the analysis.

In a retrospective analysis the researcher uses past history in the form of accumulated quantitative and qualitative data on alternative approaches to the same problem in order to determine which is more cost efficient. A retrospective cost benefit analysis deals only with realities which prevailed during the period under review, drawing data from real, observed events. Cain and Robinson (1969) describe retrospective analysis as a more stringent technique often used in the area of social action programs.

The present study is a retrospective study which deals not with artificially controlled conditions, but with realities which are commonly found when programs are applied in practice. In the field of education, retrospective cost benefit analysis is beginning to occupy a secure position in the armamentarium of program monitoring techniques, such as formative evaluation and impact assessment techniques, such as summative evaluation (McMillan & Schumacher, 1984; Popham, 1988).

Assumptions

This study is predicated on the following assumptions: first, since the vast

majority of dental therapists are assigned to rural and isolated communities, and provide dental care to satellite communities, it is assumed that they are reaching large numbers of previously under-served people.

Second, the only sound business reason for employers providing specific training programs followed by full-time employment for successful graduates is that the results obtained will be commensurate with the resources consumed.

Third, the cost of the dental therapy program is composed of costs of training and costs of employment and that this total program cost is significantly off-set by the cash value of services provided by dental therapist trainees and by graduate dental therapists employed by Health and Welfare Canada.

Fourth, increasing levels of productivity of dental therapists will increase variable costs. These additional variable costs of dental supplies, where explicit, enter into the costs calculations. The omission of other variable costs are not thought to alter the outcome of the study since an implicit assumption of this study is that increased productivity by dental therapists has a stronger upward force on benefits than on costs of additional dental supplies since the per unit cost of supplies is less when purchased in larger quantities and the fees payable by a patient for a specific dental procedure are predicated, by the dental associations, on a margin of profit.

In addition, the study was guided by the following procedural assumptions:

- all trainees are assumed to graduate in minimum time (two years);
- the total cost of training can be attributed to the number of graduating dental therapists accepting employment as operating dental therapists in Health and Welfare Canada;

- the productivity of dental therapists is expressed in relative value units (RVU);

- the productivity of dentists is expressed in relative value units;

- a relative value unit is an adjusted time unit of care for which charges are made by dentists;

- the cash value of services provided by dental therapist trainees and by graduate dental therapists employed by Health and Welfare Canada is similar to charges made by dentists for similar services.

Definition of Terms

A number of terms have been used throughout this study. In order to avoid ambiguity the following definitions are provided:

Auxiliary Health Personnel are paid health workers in a particular field with less than full professional qualifications in that field who assist and are supervised by a professional health worker.

Benefits refer to those goods which are quantifiable in money terms which accrue to a person, an institution or society as the result of investment of resources in a particular project.

Continuing education is defined as a planned, organized learning experience, occurring after basic training, and designed to maintain competency and improve quality of patient care.

Costs are the total money expenditure required to achieve something (accounting definition).

Cost-benefit analysis is a form of economic analysis where the costs and consequences of a project are quantifiable and expressed in money terms.

Dental Therapist is an operating dental auxiliary who has successfully completed two years of formal classroom and practical training who is qualified to perform a limited range of diagnostic, preventive, and curative services in dentistry, and whose work is supervised directly or indirectly by a dentist. Equivalent terms in the literature are Dental Nurse and School Dental Nurse.

Fee-for-service refers to a charge per item of dental goods and services received.

Indian and northern communities refer to Indian reserves in the provinces and all communities of the Yukon and Northwest Territories.

Human capital is an economist's term referring to the stock of human beings employed in the production process.

Professional health workers are health workers trained to the general accepted level for their discipline. They have generally received a higher education.

Relative value unit (RVU) is the common measuring and costing unit when dental services are measured in time blocks. It refers to a single work productivity index given to all clinical procedures. The method is based on expressing all operative dental procedures in terms of tooth surfaces restored because most of the operative procedures are amalgam and resin restorations. Other clinical procedures such as extractions, crowns, etc. are given values equivalent to restored tooth surfaces. For example, if a one surface amalgam restoration is rated as one RVU, a more time-consuming activity may be 1.5 or 2 RVUs. Charges are made based on the fee

chargeable for one RVU.

Shadow price is a price estimated for a cost or a benefit when market prices are considered not to be an accurate reflection of the real value, or when no market price exists (Mills & Thomas, 1984).

Limitations of the Study

The present investigation is limited only to the dental therapy program under the auspices of Health and Welfare Canada and its representatives. The study is concerned solely with the direct economic costs and benefits to Health and Welfare Canada. Subsequently, all costs and benefits are described specifically from the perspective of Health and Welfare Canada.

The study is concerned only with *ex post* analysis. Subsequently, discounting of costs and benefits to future value was not warranted. Since this type of economic analysis was not initially built into the project design, not all required data were collected at the outset. No *ex post facto* arrangements for collecting these data could be made. As a result certain non-training costs could not be disaggregated from the training cost of the program.

Another limitation of the study involves the question of accuracy. In this respect the study is bound to all of the limitations inherent in any cost-benefit analysis. Cost-benefit analysis focuses on the benefits of a program which can be estimated in quantitative terms. Since there is no important problem in which all the relevant factors can be reduced to numbers, cost-benefit analysis will never provide the

complete answer to any important problem.

Dental health education is a significant and essential component of the work of dental therapists. It is provided in the context of individual chairside oral hygiene instruction and diet education, classroom presentations to school children, prenatal/postnatal classes for expectant and new mothers, and discussions with parents, teachers, and community leaders. Although the cost of this "invaluable" service is included in the study, there is little quantifiable information on its potential impact on dental health costs. It is generally considered to result in a resource savings to the health care agency in the form of reductions in treatment costs. Its efficiency has not been adequately tested under field conditions.

Data were obtained from financial and personnel records, dental therapists productivity reports, official records and from a questionnaire survey. The primary methods of analysis of survey data were analysis of variance, *t*-test of independent means and correlation coefficients. Following a correlational study, inference is limited to the existence of relationships among variables, but cannot infer that changes in one variable cause changes in a second. Correlation coefficients merely indicate the strength of the relationship between variables and it is left to the researcher to determine the reasons for the correlation.

As is the case with most economic analyses, the present study is not free of methodological issues. According to some economists the present study may more accurately be referred to as a cost-effectiveness analysis. The logic of this methodology is that benefits are measured in terms of costs avoided. Huenenmann (1989)

states that when the costs of two alternatives are being compared, one cost of which is the costs avoided by rejecting a more expensive option, one may easily be lulled into thinking it is a cost-benefit study when it is really a cost-effectiveness study. Drummond, Stoddart, and Torrance (1987), however, argue that when only the costs of the two alternatives are examined the analysis performed may be properly referred to as cost analysis. The literature in human resources development (Carnevale & Schulz, 1990; Kober, 1982; Spencer, 1984) takes the position that cost-avoidance is a legitimate benefit of training programs. Since the present study implicitly asks if Health and Welfare Canada should be involved in training dental auxiliaries, the study has identified cost-avoidance as one of the benefits of training dental therapists.

Another methodological issue that requires explanation is the approach to the valuation of costs and benefits using shadow prices. According to Drummond and Stoddart (1985) in certain circumstances market prices may deviate from true opportunity costs and shadow prices should be calculated. The present study includes an economic evaluation of a dental health delivery scheme administered by the government to rural and isolated, economically disadvantaged Indian and Inuit communities. The price of dental goods and services provided in better-off urban centres does not accurately reflect the social justice in providing health care to economically disadvantaged and geographically isolated Canadians. The recommendation of cost-benefit methodologies is therefore to use a system of shadow prices when valuing the costs and benefits of such programs. The present study does not employ shadow prices. In general, there is not much in the literature on actual economic evaluation of health

programs using shadow pricing (Mills, 1985a).

Summary

The training and employment of dental therapists in Indian and northern communities was undertaken by the Canadian government to relieve the limited access of these communities to dental care. The cost of health care in Canada is spiralling at an alarming rate. As government funds become scarcer, policy may dictate that government sponsored programs for training and employing new types of health manpower will have to become accountable economically. Although there is theoretical evidence that the training and employment of dental therapists by the Canadian government is cost beneficial, to date there is no empirical evidence to support this claim.

CHAPTER II

TRAINING AND UTILIZATION OF DENTAL THERAPISTS: RELEVANT CONSIDERATIONS

The purpose of this chapter is to examine some of the relevant considerations in the training and utilization of dental therapists in Canada. The chapter is divided into six sections. The first section addresses the Federal Government's responsibility for dental care to status Indians and Inuit. The second section distinguishes dental therapists from other dental personnel. The third section discusses the justification for dental therapists from the Canadian perspective. The fourth section reviews the training of dental therapists. The fifth section discusses the standardization of the program. The sixth section examines the causal relationship between the program's attributes (objectives, activities, services) and the program outcomes.

Dental Services for Indians and Inuit

Although the provision of health services in Canada is a provincial responsibility, Medical Services Branch, Department of National Health and Welfare, is responsible for health services, including dental care, to status Indians and Inuit people in Canada's provinces and for the total population of the Yukon Territory. Since 1986 Health and Welfare Canada (HWC) has undertaken extensive consultation with Indian communities for the transfer of health services to community control. By 1991 eight transfer agreements had been signed. The transfer of health services for the total population of the Northwest Territories was transferred to the Government of the

Northwest Territories in April, 1988.

The objective of the dental health program of Medical Services Branch is to ensure that Indian and Inuit clients have access to and receive effective therapeutic and preventive programs equivalent to that available to other Canadians living in similar geographic locations. The long term objective is to improve the dental health status of the Indians and Inuit of Canada by providing or arranging for the provision of dental treatment services, disease prevention programs, and dental health education programs.

The dental program offered through Medical Services Branch provides a full range of basic preventive and treatment services. This includes the normal diagnostic procedures, including X-rays, all preventive services, restorative services using amalgam alloys and composite resins, prosthodontics, periodontics, and oral surgery. Crown and bridge dentistry and orthodontic treatment are not provided as a matter of routine but may be covered with appropriate approval.

Dental services are provided in both government operated dental clinics and in dentists' private practices. The government clinic service is designed to be mobile. Portable equipment is set up in nursing stations, health stations, and schools. In 1990 there were 12 dentists and 50 dental therapists employed as federal public servants with an additional 23 dental therapists employed in the Northwest Territories.

The Canadian dental therapist is a new type of dental worker. Although the Canadian dental therapy program is unique in North America, the concept is not new. The program is modeled after the New Zealand dental nurse but adapted to meet the particular needs of small rural and isolated communities, particulary in the north.

Dental therapists are persons usually with high school education or more, trained over a two year period to a defined level of competency in the techniques of basic restorative and preventive dentistry. In the field dental therapists carry out treatment plans specified by supervising dentists. Two distinguishing features of the federal and territorial dental therapy program are that dental therapists are trained to treat both children and adults, and, in addition to preventive and treatment procedures, they conduct chairside patient education activities, group educational projects in the classroom, and maintain close liaison with school teachers and administrators.

Categories of Dental Health Personnel

Dental personnel are grouped into two major categories: professional personnel and dental auxiliary personnel (Allred, 1977; WHO, 1977). Professional personnel are dental practitioners having degrees from a university or college of dentistry and who are registered to practice dentistry (WHO, 1977). Professional personnel include dental practitioners with specialized training and experience in one of the recognized branches of dentistry. Dental auxiliary personnel is a term used to refer to a wide variety of persons trained to a defined level of competency in some aspects of the practice of dentistry but who do not hold a dental degree (WHO, 1977).

There are several different kinds of dental auxiliary personnel known by many different names. Subsequently, dental auxiliary personnel are classified into one of two groups depending on the functions they perform: non-operating personnel and operating personnel. Non-operating personnel are auxiliaries who "assist dentists and

operating auxiliaries in their clinical work, but do not independently carry out any intraoral procedures. They have usually acquired technical training either in formal courses or during an apprenticeship" (WHO, 1977, p. 10). Examples of non-operating dental auxiliary personnel are dental laboratory technicians, chairside assistants, dental preventive workers, etc. Operating personnel are auxiliaries who "by virtue of having undergone formal training, perform a limited range of diagnostic, preventive, and curative services in dentistry, and whose work is supervised by a dentist, either directly or indirectly depending on national regulations. Such personnel have usually not completed dental education at university or equivalent level" (WHO, 1977, p.10). Examples of operating dental auxiliary personnel are dental nurses, dental therapists, and dental hygienists.

The "dental nurse" and "dental therapist" are more or less synonymous terms that describe an operating auxiliary who in some countries are legally permitted to treat special groups within the population. usually school children and people living in geographically isolated regions (Bedford & Davey, 1987; Burt, 1983b). They have approximately two years of formal training and upon successful completion are qualified to deliver local anaesthetics, prepare cavities, place restorative materials, and extract primary and, in some instances, permanent teeth (Allred, 1977; Roder, 1978; Waldman & Marinelli, 1985; WHO, 1959). They also carry out scaling, cleaning, and polishing of teeth, apply topical fluorides, and provide dental health education. They are distinguished from the "expanded duty dental auxiliary" who restores cavities prepared by dentists but who does not prepare cavities nor extract teeth (Allred, 1979;

Elderton, 1974; Waldman & Marinelli, 1985).

Justification of Dental Therapists

Down through the years vast differences have existed in the levels of health of the Indian and Inuit population and that of the general Canadian population. Aboriginal Canadians are a widely dispersed population, often living on difficult terrain in small isolated and semi-isolated communities, whose cultural patterns, changing and changed dietary and lifestyle patterns create direct threats to dental health. Indications are that the dental treatment requirements of this client group are more than four times that on the average for all Canadians (HWC, 1984). Although efforts were consistently made in the past to recruit Canadian dentists to provide treatment to this segment of the population, very little response was received as service demands in urban areas were more than sufficient to maintain heavy practice loads for the dental practitioner. When dentists could be available, it would only be for a short time for emergency treatment only consisting mostly of extractions.

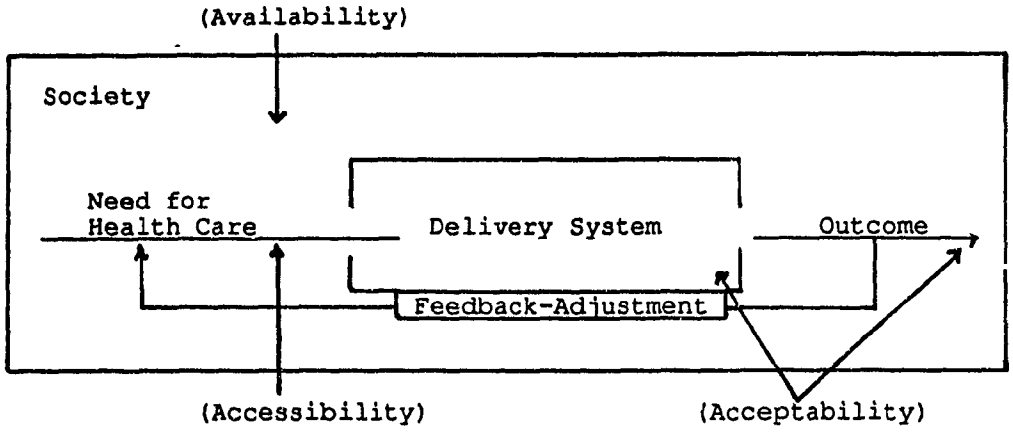
The chronic disparity between rising dental health care needs in Indian and northern communities and the limited resources available for coping with them spurred the development of a new type of health personnel to address the dental care needs of this population. In September 1972, the dental therapy program in Canada was established when Medical Services Branch of the Department of National Health and Welfare opened a School of Dental Therapy at Fort Smith in the Northwest Territories in order to train dental therapists in basic dentistry including fillings, extractions and

preventive dental services.

Thus, the rationale for training and utilizing dental therapists was structured around two crucial elements of health care delivery: the need for care and access to care. Although the dental therapy program has been operating for almost 20 years, the following discussion will demonstrate that the original justification remains valid.

Access to care is related to availability, accessibility, and acceptability of dental care. Access is a function of the classical health delivery model and its environment. This is shown graphically in Figure 1 using the systems-environment model.

Figure 1
Systems-Environment Model of Access to Health Care



The society in general, whether a province, a region, or a community, is the context, or the environment in which the health care delivery model operates. Availability is a statement of the general presence or absence of providers in the system's environment. Accessibility refers to the ability of the consumer to enter the delivery system. According to Dunning (1979) this is a function of location, economics,

culture, communication and transportation. Fundamental to the concept of accessibility is the notion of convenience in terms of distance and time which separates the consumer from appropriate dental services. Acceptability is an attitudinal measure referring to consumers' satisfaction with the provider, the service, and the outcome (Dunning, 1979).

Availability

In the decades since 1961 there have been steady and significant improvements in the dentist-to-population ratio in Canada (Canadian Dental Association, 1980; HWC, 1990). However, when the 1985 Canadian dentist-to-population ratio is compared to the dentist-to-population ratio in the same year for other modern industrialized countries (see Table 1), it can be seen that Canada ranked 13th after 10 European countries, 1 Middle East country, and the United States.

Table 1
1985 Dentist-Population Ratios for Fourteen Countries

Country	Ratio/10,000	Country	Ratio/10,000
Sweden	11.0	Israel	7.1
Finland	9.3	E. Germany	7.0
Norway	8.9	Belgium	6.1
Denmark	8.8	U.S.A.	5.9
Greece	8.5	W. Germany	5.7
Iceland	8.1	Canada	4.9
France	7.2	Luxembourg	4.1

Source: World Health Organization (1989). World Health Statistics Annual 1988. Geneva: World Health Organization.

It needs to be pointed out that although the above figures provide excellent comparative data, they should not be interpreted as providing suitable manpower goals. The dentist-to-population ratio for any of the 13 countries above Canada can only be interpreted in the light of additional knowledge of the dental health status of the countries, the number of dentists in full-time service to the public, and the availability of dental auxiliaries to extend and support the work of dentists. However, relative to countries of similar social and economic development, Canada appears to have comparatively fewer dentists.

In 1962 Canada had one dentist for each 3,100 people (Chebib, 1973). By 1982, this ratio had improved to one active dentist for each 2,080 people with further improvements by 1989 to one active dentist for each 1,896 people (see Table 2).

Table 2
Canadian Population per Active Licensed Dentist, Full-Time and Part-Time, 1985-1989.

	1985	1986	1987	1988	1989
Population	25,274.0	25,499.7	25,795.8	26,095.2	26,440.4
No. of Dentists	13,027	13,164	13,503	13,742	13,997
D/P Ratio	1,940	1,937	1,910	1,899	1,896

Source: Health and Welfare Canada (1990). Health Personnel in Canada - 1989. Ottawa: Supply and Services Canada.

These indicators, calculated for the national level, are of interest as an initial approach, but conceal the internal variations. When the 1989 dentist-to-population ratio is examined by provinces and territories, considerable disparities are revealed

(see Table 3). The variations within the provinces and territories themselves are of even greater concern. Furthermore, concealed in these figures are the variable proportions of dentists in part-time practice and those working in institutional settings not directly linked to the production of dental services (Canadian Dental Association, 1980). It is evident that the number of dentists available in some provinces is inadequate to meet the need for care among the population.

Table 3
Population per Active Licensed Dentist, Full-Time and Part-Time by Province of Residence, 1989.

Province	D/P Ratio	Province	D/P Ratio
Northwest Terrs.	1:1,529	Nova Scotia	1:2.127
British Columbia	1:1,534	Quebec	1:2,135
Yukon Territory	1:1,613	Prince Edward Is.	1:2,512
Ontario	1:1,702	Saskatchewan	1:2,575
Alberta	1:1,818	New Brunswick	1:3,283
Manitoba	1:2,074	Newfoundland	1:4,143

Source: Health and Welfare Canada (1990). Health Personnel in Canada - 1989. Ottawa: Supply and Services Canada.

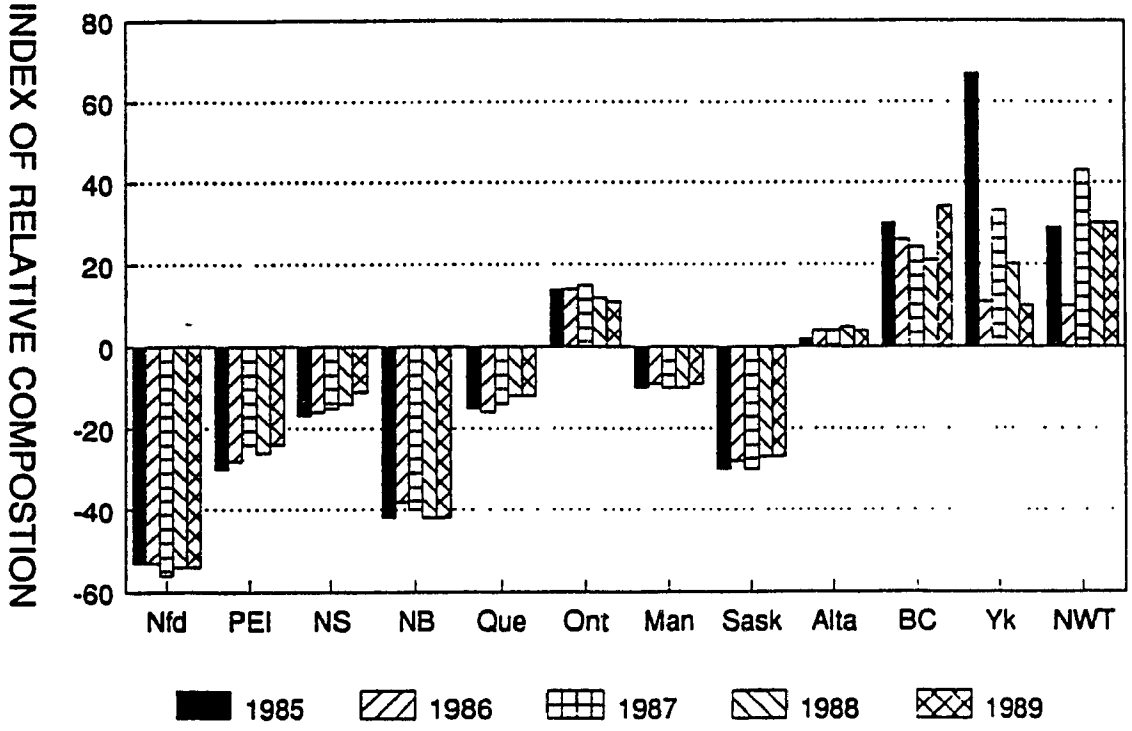
The disparity in the distribution of Canada's supply of dentists may be more closely examined by comparing the percentage of the nation's population residing in a given province with the percentage of the nation's supply of registered, active dentists residing in the same province. The disparity, the difference between the percentage of dentists and the percentage of the nation's population of a given province, is shown in Table 4. Each difference shows whether the province has a relative surplus (+) or deficit (-) of dentists in comparison with its share of the Canadian population (Bogue,

Table 4
Disparity between the Percentage of Population and the Percentage of Dentists Residing in Each Province or Territory, 1985-1989.

	1985			1986			1987			1988			1989		
	% of Dentists	% of Pop'n	Dis-Parity	% of Dentists	% of Pop'n	Dis-Parity	% of Dentists	% of Pop'n	Dis-Parity	% of Dentists	% of Pop'n	Dis-Parity	% of Dentists	% of Pop'n	Dis-Parity
Newfoundland	1.05	2.25	-1.20	1.04	2.22	-1.18	1.00	2.25	-1.25	1.00	2.18	-1.18	0.99	2.17	-1.18
Prince Ed. Is.	0.35	0.50	-0.15	0.36	0.50	-0.14	0.38	0.50	-0.12	0.37	0.50	-0.13	0.37	0.49	-0.12
Nova Scotia	2.86	3.44	-0.58	2.89	3.44	-0.55	2.94	3.45	-0.51	2.93	3.39	-0.46	2.99	3.36	-0.37
New Brunswick	1.64	2.81	-1.17	1.74	2.79	-1.05	1.68	2.81	-1.13	1.60	2.74	-1.14	1.57	2.73	-1.16
Quebec	21.92	25.88	-3.91	21.72	25.76	-4.04	22.33	25.82	-3.50	22.43	25.55	-3.12	22.54	25.48	-2.94
Ontario	40.89	35.90	+4.99	41.21	36.10	+5.11	40.70	35.40	+5.30	40.79	36.46	+4.33	40.57	36.56	+4.01
Manitoba	3.82	4.23	-0.41	3.86	4.22	-0.36	3.82	4.23	-0.41	3.75	4.15	-0.40	3.74	4.11	-0.37
Saskatchewan	2.82	4.00	-1.18	2.86	3.96	-1.10	2.82	4.00	-1.18	2.83	3.86	-1.03	2.78	3.79	-1.01
Alberta	9.47	9.33	+0.14	9.65	9.31	+0.34	9.70	9.33	+0.37	9.68	9.26	+0.42	9.62	9.26	+0.36
Br. Columbia	14.78	11.41	+3.37	14.35	11.31	+2.94	14.20	11.41	+2.79	14.07	11.61	+2.46	15.75	11.75	+4.00
Yukon	0.15	0.09	+0.06	0.10	0.09	+0.01	0.12	0.09	+0.03	0.12	0.10	+0.02	0.11	0.10	+0.01
N.W. Terrs.	0.25	0.21	+0.01	0.22	0.20	+0.02	0.30	0.21	+0.09	0.26	0.20	+0.06	0.26	0.20	+0.06

Disparity equals the percent dentists minus percent population.

Fig. 2
Indices of Relative Compostion of Dentists to Population Percentages by Provinces and Territories, 1985 - 1989



1969). The index of relative composition (Bogue, 1969) reveals the relative importance of these differences, some of which look deceptively small, by expressing the disparity as a percentage of the province's total population (See Fig. 2). The index of relative composition is like a zoom lens allowing us to zoom in on specific subcategories of population and compare their differential composition.

In the most recent five years for which data is available, 1985 to 1989, Ontario, British Columbia and Alberta have consistently had a higher percentage of dentists than of the nation's population. The disparity in Ontario appears relatively steady, whereas the disparity in British Columbia decreased somewhat between 1985 and 1988, only to resurge in 1989 to exceed the disparity of the four preceding years. Alberta has had the least disparity among the three, though a progressively increasing disparity. These trends become particulary clear in Figure 2.

Newfoundland had the greatest disparity between its share of Canada's dentists and population, and further displays a strong persistent undersupply of dentists in proportion to its share of the nation's population. Newfoundland is followed closely by New Brunswick which shows a slight decrease in disparity only in 1986. Prince Edward Island and Saskatchewan both rank third in the undersupply of dentists in proportion to their share of the nation's population. Nova Scotia, Quebec, and Manitoba also had a considerably smaller number of dentists than their share of population warranted.

The Yukon, and to a lesser extent the Northwest Territories, reveal highly fluctuating trends. Their disparity gymnastics result from large differences based on

very small percentages. When a region has an extremely small percentage of the nation's population such as the Yukon and Northwest Territories, a minor change in population or number of dentists can cause major percentage shifts. In general, it can be said that both the Yukon and Northwest Territories reveal an oversupply of dentists in proportion to their share of the nation's population.

In summary, Figure 2 reveals an imbalance in the proportional distribution of the nation's population and the nation's supply of dentists. An oversupply of dentists relative to their percentage of the nation's population is evident in British Columbia, Ontario, and Alberta. An undersupply relative to their percentage of the nation's population prevails in Newfoundland, New Brunswick, Prince Edward Island, Saskatchewan, Nova Scotia, Quebec, and Manitoba. The Yukon and Northwest Territories reveal a general oversupply of dentists in comparison to their share of the nation's population.

Accessibility

Stewart (1990) referred to accessibility as implying "a continuing and organized supply of care that is geographically, financially, culturally, and functionally within easy reach of the whole community" (p.451).

With regard to geographical accessibility, the dentist-to-population ratio and the index of relative composition are important indices. It may be concluded that provinces having a considerably smaller number of dentists than their share of population are predisposed to suffer from inequalities in dentist density from one

geographical location to another. This does not mean that provinces or territories with an availability of dentists which exceeds their share will have uniformly better accessibility. For example, the Northwest Territories has a surplus in their share of the nation's dentists in comparison to their share of the nation's population. On the other hand, the Northwest Territories has a land mass of 1.2 million square miles - the size of India or one-half the size of the United States - with a population of only 46,000 scattered in remote and isolated settlements (Bedford & Davey, 1987). The oversupply in availability of dentists in the Northwest Territories does not make them accessible to all members of the population requiring their services as most of these communities are not accessible by land, none of them can support a private dental practitioner nor would any dentist relocate his practice to such remote locations (Bedford & Davey, 1987).

McFarlane (1964), House (1970) and Chebib (1973) showed that the distribution of dentists in Canada is highly skewed toward urban areas so that residents of more remote areas suffer from limited services. Fowler and Hunt (1976) surveyed the oral health status of 2,222 adults aged 25 to 44 in Ontario and found a significant relationship between more inaccessible dental services and more decayed and missing teeth and fewer successfully filled teeth. It was questioned whether such dental health differences were due to reduced access to care or due to characteristics associated with rural lifestyle (Canadian Dental Association, 1980). Although lifestyle is influenced in part by the environment, impaired access to dental care also implies delayed interventions, reduced dental check-ups and less dental health education and promotion.

Table 5
Estimated Percentage Distribution of Indian and Inuit Communities by Geographical Classification and Population - 1989.

Geographic Classification	Community Size			Total
	Up to 299 %	300 to 999 %	1000+ %	%
Isolated[1]				
Communities	23	10	1	34
Population	9	20	6	35
Rural[2]				
Communities	30	10	1	41
Population	9	18	6	33
Urban[3]				
Communities	16	6	3	25
Population	5	10	17	32
Total:				
Communities	69	26	5	100
Population	23	48	29	100

1) Isolated: Also classified as remote and refers to communities over 350 km from an urban centre and communities not accessible by year-round road, e.g., a fly-in community.
2) Rural: Refers to a community that is located between 50 km and 350 km from an urban centre, a centre of 10,000 and over, and that has reasonable means of transportation.
3) Urban: Refers to a community located within 50 km of an urban centre, i.e., a centre of 10,000 and over, not necessarily Indian or Inuit.
The total population size on which this table is based is 310,000; the total number of communities on which this table is based is 915.

Source: Indian and Northern Affairs Canada, (1990). Basic Departmental Data: 1990. Ottawa: Indian and Northern Affairs Canada.

Indian and Inuit communities are among the most rural and isolated communities in Canada. Table 5 shows the 1989 estimated percentage distribution of Indian and Inuit communities in Canada by geographical location and by size of the communities. The population data in Table 5 are based on Registered Indians and Inuit living on reserves, crown lands, and settlements.

Based on the data in Table 5 it can be estimated that about 686 or 75% of the total number of Indian and Inuit communities are classified as rural or isolated. These are inhabited by 210,800 or 68% of the Indian and Inuit population living on reserves, crown lands and settlements. This figure taken along with the population living at the periphery of the urban classification reveals that most Indian and Inuit communities in Canada are typically rural, having small populations unable to support a private dental practitioner and located in isolated areas where health services and facilities are scarce (Bedford & Davey, 1987). Shortages of primary dental care in these communities are further compounded by the isolation factor which makes transportation and the delivery of supplies and services both costly and difficult.

With regard to economic accessibility, the costs of dental care for Status Indians and Inuit are borne by Medical Services Branch under the Non-Insured Health Benefits Program (HWC, 1989). Therefore, economic accessibility in terms of affordability is not a major issue for Status Indians and Inuit. It is an issue for the estimated one million Métis and non-status Indians and Inuit who live in the same and in adjacent communities and who are responsible for the cost of their dental care.

The so-called economic advantage provided by Non-Insured Health Benefits to Status Indians and Inuit should not detract from the important relationship between socio-economic status and health. As previously stated, the majority of aboriginal communities are located in remote and isolated areas. Remoteness tends to hinder economic progress resulting in low levels of labour force participation by Canada's aboriginal peoples. There is an abundance of literature identifying the economically

disadvantaged as a high-risk target group for diseases and disabilities because of poorer health status and health behaviours (Stewart, 1990).

The cost of dental care for Status Indians and Inuit is a concern of the Federal government. Since 1979 when the Indian Health Policy was implemented, the cost to the Federal Government for dental services for eligible Indians and Inuit increased from $6.4 million to $74.5 million in 1991, or an 1,1158 percent increase. Recent new legislation will further contribute to the cost of dental care. Bill C-31 provides for the reinstatement to Indian status of a number of previously disenfranchised Indian people. The 1989 projection relating to the number of eligible Indians is 112,000 (HWC, 1989). This is certain to result in greater demands for service and thus have a significant impact on the cost of dental care to the Canadian government in future years (HWC, 1989).

Acceptability

The acceptability of dental therapists refers to acceptability by the communities they serve and acceptability by the dental profession. An important measure of acceptability by the community is the extent to which dental therapists are perceived by communities as meeting their felt needs. As much as it distresses our public health sensibilities, when health problems are great in a community, the felt need is primarily for treatment services to relieve pain and discomfort (Wray, 1973). If program emphasis is placed predominately on prevention, acceptance can be expected to be low. Dental therapists provide both treatment and preventive services. Since dental

therapists are meeting the "felt needs" of the community, they are more acceptable to the community which results in a more rapidly accepted preventive program (Torbert, 1990).

In the absence of available survey data on the "fit" between dental therapist services and the felt needs of native communities, dental therapists' productivity figures form a good proxy indicator of acceptability since consumer participation is an important index of acceptability. The fallacy of relying entirely on productivity figures is that as indicators they tell us more about the level of activity and do not necessarily relate activities to perceived needs (Berman, 1984). Since dental therapists' clinical services are demand driven, and given the voluntary nature of service utilization, it may be assumed that there is a positive correlation between dental therapists' productivity figures and client acceptance of dental therapists.

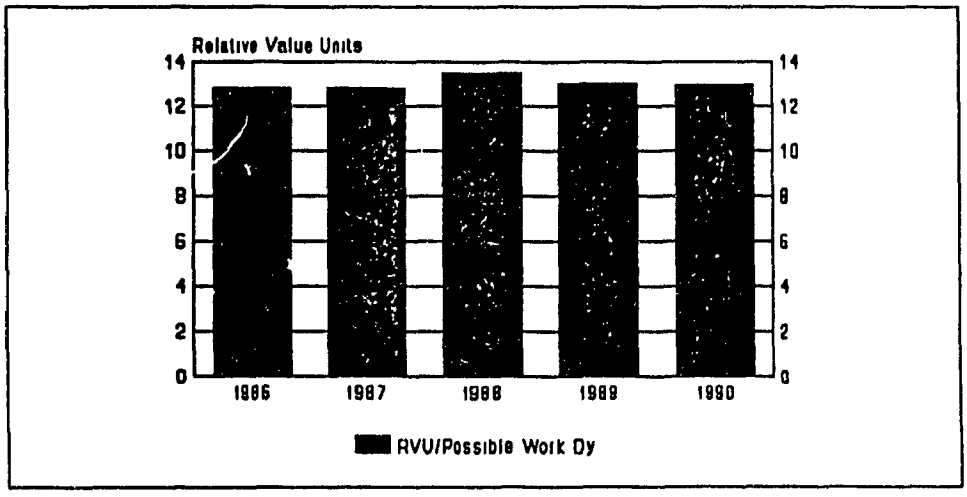
Dental therapists' productivity is measured in Relative Value Units (RVUs). The relative value system develops a reasonable relationship between all services on the basis of the variables "time" and "responsibility". The basic time factor for any given dental procedure is ¼ hour as established by the Canadian Dental Association (1965). The responsibility factor uses a base value of 1.0. Therefore, 1 RVU represents 15 minutes of work at a base responsibility level of 1.0. This permits a comparison of the relative amount of work necessary to produce one dental service output against another.

Most dentists working with a chairside assistant should be able to produce the equivalent of 4 RVUs per hour or 28 RVUs per 7 hour day. This work index is not

realistic for dental therapists who do not work with the aid of a chairside assistant, and who must additionally perform all necessary administrative and infection control procedures. Also since most dental therapists serve more than one community, their clinic is portable and time must be spent in packing, transporting and unpacking all dental equipment and instruments. They are also trained to repair and "trouble-shoot" this equipment. Subsequently, given these constraints, an acceptable expectation for dental therapists working within the framework of a well-balanced program is 12-14 RVUs/possible work day (NSDT, 1990).

Figure 3 displays the average number of RVUs produced by dental therapists per possible work day between 1986 and 1990. Dental therapists on the whole are meeting optimum productivity levels, indicating full utilization of dental therapist services by client communities.

Figure 3
Average Number of Relative Value Units by Dental Therapists per Possible Work Day, 1986-1990.



An important factor in the acceptability of dental therapists to native communities is the fact that many dental therapists are individuals of native ancestry. Their social and ethnic backgrounds, individual styles, and natural empathy with native people place them in a better position to treat and counsel successfully. Most dental therapists are also residents of the communities in which they work, participating fully in community life, providing continuity in service and care including a comprehensive preventive program. This stands in stark comparison to the alternative situation in which treatment is either entirely absent, inadequate or spasmodic. When patterns of treatment between itinerate dentists and local resident dental therapists are compared, the statistics reveal that the dentists see more patients but perform less number of treatments per patient and are more often prone to extract teeth; whereas the dental therapist tries to complete all the necessary work for the patient and places a strong emphasis on restorative care (HWC, 1987). This provides a solid line of evidence of the continuity and comprehensiveness of services provided by dental therapists.

The influence of the dental profession, clinically and professionally, is important to the acceptability of dental therapists. Although there are many dentists who support the idea of dental therapists, there still remains opposition to the training and utilization of dental therapists by some of the leaders in dentistry. To help secure credibility of the dental therapist concept with the dental profession, as well as the public, an affiliation was established in 1972 between the School of Dental Therapy and the Faculty of Dentistry of the University of Toronto. Under the present arrangement the National School of Dental Therapy operates under the auspices of the Faculty of

Dentistry of the University of Toronto by contractual arrangement between Medical Services Branch and the University. The School's director is a professor of dentistry from the University.

Many dentists and most provincial dental associations are not yet fully persuaded of the utility of dental therapists. Private practitioners fear that future career encroachment by dental therapists might reduce dentists' economic well-being and dentists' control over dentistry. At present, the scope of work of dental therapists is controlled by several means. The population groups that they treat are limited to registered Indians and Inuit residing on reserves and crown lands in Canada. The scope of practice of dental therapists is limited and carefully defined. All diagnosis and treatment planning is the dentists' direct responsibility. Therefore, dental therapists are not trained to compete with private practice. They provide care and treatment to the extent their precisely defined training will allow. More complex problems are referred by dental therapists to dental practitioners for care and service.

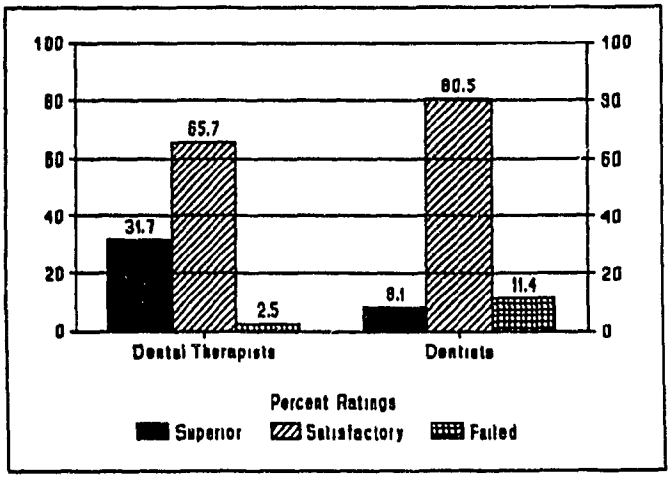
A concern of the dental associations is that the dental therapy program could result in second-rate, substandard care. A recent study by Crawford and Holmes (1989) demonstrated that restorations placed by dental therapists were rated equal or better than those placed by dentists servicing the same client population (Appendix I).

In the Crawford/Holmes study the technical perfection of dental restorations completed by dental therapists was compared with that of restorations placed by dentists. A total of 1,860 restorations in 323 patients in five northern communities were examined. The number of dental therapists and dentists represented in this study

was not reported by the researchers. However, the number of dental therapists involved in the study is known by the present researcher to be at least eight. Dental examinations were performed with a mirror and explorer. An index to measure quality was used to rate restorations as "excellent" (Romeo), "acceptable" (Sierra), or "failed" (Tango). The evaluation of restorations was of the "blind" type in that the evaluators did not know whether restorations had been placed by a dentist or a dental therapist.

Figure 4 summarizes the evaluation of restorations placed by dental therapists and dentists. Of the 983 restorations placed by dental therapists, 31.5 percent were rated as "excellent"; 65.7 percent were rated as "acceptable"; and only 2.5 percent were judged to fall in the "failed" category. Of the 877 restorations completed by dentists, 8.1 percent were rated as "excellent"; 80.5 percent were rated as "acceptable" and 11.4 percent were classified as "failed".

Figure 4
Quality of Restorations Placed by Dental Therapists and Dentists



The evaluators reported that restorations placed by dental therapists were of consistent quality, and that

> ...wherever therapists (sic) [restorations] were observed, the quality of work was good to excellent. There was hardly a case where a failed restoration was observed (Crawford & Holm, 1989, p.14).

The overall results thus indicate that the restorations placed by the dental therapists in this study were equal to, if not better than, restorations placed by dentists serving the same clients.

Training of Dental Therapists

The National School of Dental Therapy operates under the auspices of the Faculty of Dentistry, University of Toronto, by contractual agreement between Health and Welfare Canada (Medical Services Branch). The Director of the school is a professor of dentistry from the University. All other staff members are likewise employees of the University.

The training of dental therapists is financed directly by Health and Welfare Canada and planned and administered by the National School of Dental Therapy in Prince Albert, Saskatchewan. Costs normally payable by students but paid on their behalf by Health and Welfare Canada include tuition, fees, books, manuals, uniforms, dental equipment, and transportation to and from student field clinics including local accommodations and meals at the field clinic sites. Costs of room and board during the classroom portion of training are paid in various ways. Some students pay these expenses themselves, but most are able to acquire partial or total sponsorship from

various government and non-government agencies to cover these costs.

The faculty of the National School of Dental Therapy consists of seven fully-licensed Canadian dentists and three experienced dental therapists. With a staff-student ratio of one dentist to five students, instructors are able to provide good supervision and give individual help where it is needed most.

The two year curriculum is composed of 2,850 total clock hours almost equally divided between science and technique instruction and direct patient care. A summary of the curriculum is found in Appendix K. The first year consists primarily of academic subjects supported by practical application of principles and skills studied and learned. Community and preventive dentistry is introduced from the perspective of clinical preventive procedures for individual patients. The students perform technic work on bench-mounted plastic mannequins. Patient care begins late in the first year involving all disciplines of dentistry and continues throughout the second year.

The second year is devoted to direct clinical patient care, clinic administration and routine clinical procedures. In community and preventive dentistry students learn to plan, provide and evaluate preventive and dental public health programs and activities within a community setting. Throughout the first and second year, seventy lecture and 1,985 hours of clinic time are devoted to restorative clinical dentistry. This is four times as much time as an undergraduate dental student spends on the subject (Petrikowski, 1988).

All subjects in the curriculum are supported by teaching materials, course notes, operations manuals, and other course material developed specifically for the program

by the staff of the school. There is also a library and study room which includes selected journals, textbooks, references, models and audio-visual material, all to promote and support student learning.

The curriculum is pertinent to the particular dental health needs of Indian and Inuit communities. Classroom instruction and clinical training are reinforced by community practice. In the latter part of the second year, students in groups of four or five accompanied by one instructor are transported to a selected remote community for a six to seven week field clinic. This avoids separation between training and actual work context by providing students with practical clinical and public health experiences similar to those they will encounter later in geographical locations also similar to those in which they will later work. It also serves the practical purpose of disclosing problems not well covered in the curriculum.

Over the past decade the National School of Dental Therapy has acquired an international reputation. In collaboration with the Governments of Mozambique and Dominica with support from the Canadian International Development Agency, trainees from these countries have been trained in dental therapy who then returned to their countries as supervisors and educators and providers of dental care within the structure of a dental auxiliary program. Other graduates of the school have come from such places as Nepal, Philippines, Zaire, Cameroons, Grenada and Jamaica. All have returned to these countries to provide primary dental care to under-serviced areas.

Standardization of the Dental Therapy Program

The dental therapy program was undertaken subject to certain conditions and was structured to follow three basic principles in order to guarantee success. These principles are essential, interrelated and dependent upon each other. They are:

(1) standardization of procedures, methods, equipment and material;

(2) quality control of the work that dental therapists do;

(3) portability of clinics.

Standardization is necessary because dental therapists are trained to function as technicians, not professionals. Accordingly, the training program has been carefully worked out and elaborately standardized such that all dental therapists are thoroughly trained to perform only specified procedures using specified methods, equipment and material. Since most graduates will carry out dental procedures in the absence of direct supervision by a dentist, they need the security of a systematic approach.

The program is standardized in almost every detail. Facilities, instruments, equipment, and supplies are part of the standardization. Standardization of the accoutrements of service delivery ensures compatibility with teaching plans and allows compatibility between the therapist and equipment no matter where the dental therapist works. Subsequently, dental therapists may transfer from one geographical location to another within the system and become fully operational immediately.

Dental Therapy Program Causal Model

The dental therapy program causal model is in effect a partial simulation of the

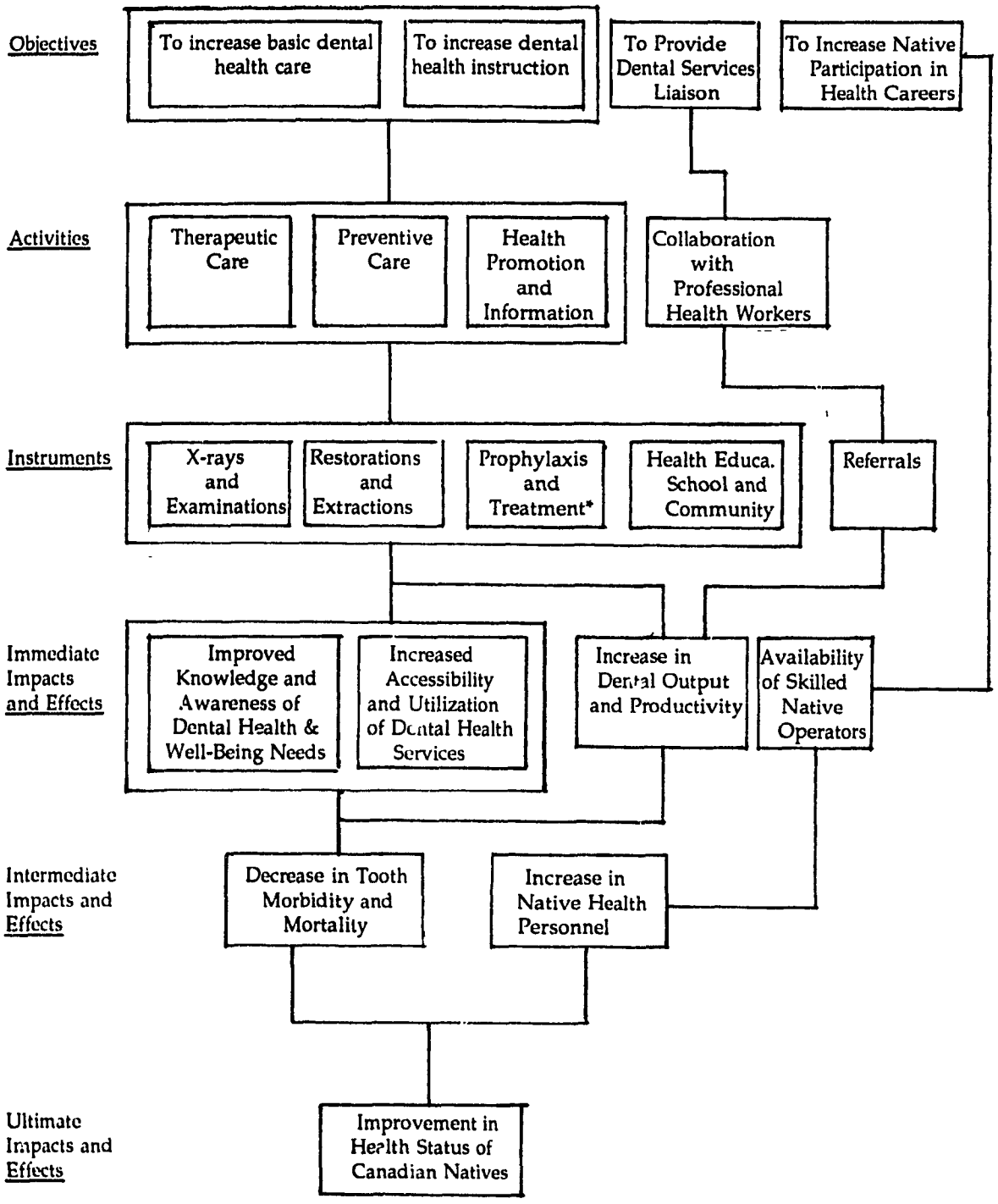
program depicting how the program operates. The causal model, diagrammatically depicted in Figure 5 on the following page, illustrates the relationship between the objectives and the activities and instruments used to attain the objectives, and the impacts and effects of these activities.

The objectives depicted in the causal model are broad service objectives derived from the overall objective of Medical Services Branch "to protect and enhance the health of those Canadians whose care, by legislation or custom, is the responsibility of [the Department of National Health and Welfare]" (p.4-11, HWC, 1989), and from the sub-objective "to assist status Indians, Inuit and residents of the Yukon to attain a level of health comparable to that of other Canadians living in similar locations" (p. 2-69 HWC, 1991).

The general objectives of the dental therapy program are related to the need to improve the dental health status of Inuit and Status Indians by increasing the quantity and quality of dental health care delivery and dental health instruction in Indian and northern communities, the provision of a link between dental health services available in the community and those available outside the community, and to increase native participation in health careers. These objectives have some points in common with the utilization of auxiliary health workers all over the world (Guilbert, 1981).

Subsumed in these objectives, but not explicit in the model, are the more specific program objectives arising from dental health care needs and demands of Indian and northern communities. These more specific objectives determine more precisely the scope of practice of dental therapists, which in turn are the instructional goals of the

Fig. 5
Dental Therapy Program Causal Model



*Treatment - application of topical fluoride and fissure sealants.

training program since the scope of practice is a statement of what dental therapists should be able to do when they have successfully completed the two year training program.

The dental therapy program is designed to achieve these objectives through a number of activities, the most important of which are grouped below the objective to which they relate (see Fig. 5). The critical link between program objectives and program activities is the dental therapist training program. The activities are in essence the cluster dental therapist competencies around which the program revolves.

The activities work toward the achievement of the desired results by employing various instruments (see Fig. 5). The instruments are in effect the various services provided by dental therapists. Each service takes the form of interventions (a combination of specific tasks and procedures) where fulfilment leads to the achievement of the program objectives. The mix of interventions assigned to dental therapists is one of the crucial, determining factors in their effectiveness. The selection of efficacious interventions results in greater health impact (Berman et al., 1986). The effectiveness of dental therapists' work depends not only on the interventions they carry out but also on the quality of the care they render (Berman, 1984). According to Berman (1984), the "selection of efficacious [interventions] and adequate quality of care combine with the appropriate health needs to create positive treatment outcomes" (p. 69). Therefore, the selection of tasks assigned to dental therapists (which determines the mix of interventions) and quality of care (which refers to the technical excellence of services) are important components of dental therapist effectiveness and cost-efficiency.

Program impacts and effects flow directly from the combination of activities and instruments. The program impacts and effects can be separated into three distinct classes in order of occurrence and dependence. The first level of impacts and effects comprises four separate but not wholly independent results. Awareness of dental health well-being and needs, improved knowledge relating to dental health and increased accessibility and utilization of dental care services are some of the immediate results of the program. An increase in dental output and productivity is also an immediate result of the program which results from the direct services provided by dental therapists and from the referral of more complex cases to dental practitioners. One of the important short-term impacts and effects is the effect of job creation and of promoting employment of Indian and Inuit people in one aspect of the health care field.

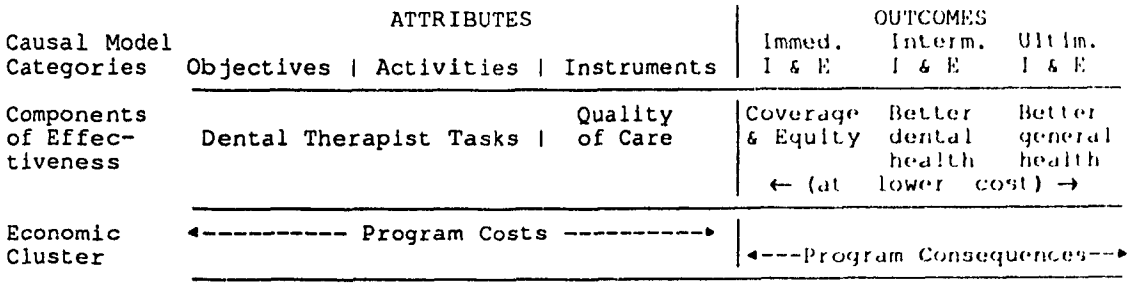
The second level or intermediate impacts and effects occur over the longer term and can only in part be attributable to dental therapist interventions. For example, dental therapists provide both clinical preventive and restorative services and oral health instruction both individually and in groups. Nonetheless, there is also a cause and effect relationship between decrease in tooth morbidity and mortality, dental health education and the decisions individuals make and the actions they take to practice good oral hygiene.

The final or ultimate impact and effect of the dental therapy program is to increase the health status of Canadian natives. This ultimate effect is not attributable solely to the program but to the combined operation of the dental therapy program and all other

components of Indian and Northern Health Services. Although not diagrammatically depicted, there is an additional obvious outcome of the dental therapy program which is derived from its justification: the delivery of important basic dental care services at low cost to previously under-served people.

The dental therapy program causal model depicts the causal relationship between program attributes (objectives, activities and instruments) and outcomes (impacts and effects). These relate directly to dental therapists' effectiveness and the costs and benefits of the program. This relationship is shown in Figure 6. The diagram in Figure 6 depicts an inference about a causal relationship between the program attributes and outcomes, and consequently, the costs incurred and the benefits accruing from the program.

Figure 6. The Relationship Between Dental Therapist Program Attributes and Outcomes, Dental Therapist Effectiveness and Program Costs and Consequences



Summary

This section discussed some of the factors relevant to the training and utilization of dental therapists in Indian and Northern communities. The section emphasized the justification for the dental therapy program and demonstrated that the original justifica-

tion for the program remains valid. Dental therapists receive two years of training in basic dental care at the National School of Dental Therapy in Prince Albert, Saskatchewan. Recent studies have demonstrated that restorations placed by dental therapists are equal to if not better than those placed by dental practitioners serving the same population. The causal model of the program depicting the relationship between the program's objectives, activities and instruments used to attain these objectives, and the resulting impacts and effects was presented.

CHAPTER III

REVIEW OF THE LITERATURE ON COST-BENEFIT ANALYSIS

Cost-benefit analysis is not a new or mysterious technique. Its use in economics may be traced back to 1844; however, it was not until the U.S. water program in the 1930's which sought to examine the cost of irrigation projects and the anticipated increase in agricultural output from the projects that cost-benefit analysis gained significant favour (Kober, 1982). In recent years, as a direct result of the increasing interest in cost-benefit analysis as one of several tools of outcome evaluation, an enormous body of literature has been generated on the theory and practice of cost-benefit analysis (Cain & Robinson, 1969; Jameson, 1981; Wood & Campbell, 1970). This chapter provides a general review of the literature on cost-benefit analysis.

Cost-Benefit Analysis Defined

The terms *cost-benefit analysis* and *benefit-cost analysis* are in frequent use. The terms are used interchangeably. According to Campen (1986), texts using cost-benefit analysis are more often of British origin, while those opting for benefit-cost analysis tend to be of American origin. Campen hypothesizes that the difference in terminology is,

> that there has been no British counterpart to the requirement, in U.S. budgetary reviews of water resource projects, that a *benefit-cost ratio* of greater than one be demonstrated for a proposed project before it could be approved (p. 10).

The term used throughout this study will be cost-benefit analysis except in direct

quotations of authors who use the alternate term.

Definitions of cost-benefit analysis have been offered by a variety of writers. Prest and Turvey (1965) are among its early exponents in the literature. They described cost-benefit analysis as,

> A practical way of assessing the desirability of projects, where it is important to take a long view (in the sense of looking at repercussions in the further, as well as nearer, future) and a wide view (in the sense of allowing for side-effects of many kinds on many persons, industries, regions, etc.), i.e., it implies the enumeration and evaluation of all the relevant costs and benefits (p.683).

A more concise definition was provided by Thompson and Fortess in 1980:

> Benefit-cost analysis evaluates a program by comparing the money-valued amount of good program effects (benefits) with the money valued bad effects (costs) (p.424).

The Treasury Board of Canada (1982) defines cost-benefit analysis as,

> A method of evaluating the relative merits of alternative public investment projects in order to achieve efficient allocation of resources (p. 3).

For the purpose of this study, cost-benefit analysis is defined as a technique for "identifying and measuring the costs associated with and the benefits [arising] from an investment" (Wood & Campbell, 1970, p. v) and where "costs and consequences are expressed in money terms" (Mills & Drummond, 1985, p. 38).

The decades following the second world war have seen a proliferation in the literature on the theory and practice of cost-benefit analysis (Cain & Robinson, 1969; Davis & Morrall, 1974; Jameson, 1981; Ray, 1984; Wood & Campbell, 1970). The profusion of explicative literature and of cost-benefit studies have contributed as much to confusion as to enlightenment (Bloom, 1986; Dinkel, 1985; Drummond & Stoddart,

1985: Warner & Hutton, 1980). This disparity in the literature is one of multiple etiology and indicates that the techniques of cost-benefit analysis are still in a state of evolution (Birch & Donaldson, 1987; Davis & Morrall, 1974; Dinkel, 1985; Treasury Board, 1982), that there is considerable variability in its application (Mills, 1985a; Rothenberg, 1975; Warner & Hutton, 1980; Zöllner, 1985), and that there are methodological controversies and flaws in some of the literature (Dinkel, 1985; Drummond & Stoddart, 1985; Mills, 1985a; Zöllner, 1985).

Drummond and Stoddart (1985) and Warner and Hutton (1980) state that one contribution to the disparity in the literature is the lack of real congruency between the titles of studies and their content. Warner and Hutton and Huenenmann (1989) offer concrete examples. The discrepancy between titles and content suggests that the research problem is not fully understood and/or the methodology used does not properly address the problem under review.

According to Drummond and Stoddart (1985), the most common methodological flaw in cost-benefit studies is related to the concept of choice, choice between alternative courses of action. Consideration of alternatives is an essential feature of prospective (before the operation of the program) cost-benefit analysis. This is particularly true for investment decisions where decision-makers must choose from a set of projects the one which promises the greatest net benefits.

Many cost-benefit studies in education and training take the form of formative evaluations such as program monitoring, and summative evaluations such as impact assessment (McMillan & Schumacher, 1984; Popham, 1988). Such evaluations are

generally retrospective studies (after the program has been in operation for some time) and answer the question: Were the results obtained commensurate with the resources consumed (Anderson & Kasl, 1982)? According to Andrieu (1977), the role of retrospective cost-benefit analysis is "to determine whether the allocation of resources has indeed been correctly made and to help identify what modifications, if any, are required for improving the program" (p. 220). The identification of alternatives is not an essential feature of retrospective analysis (Andrieu, 1977).

Reddy (1979) reflects the same view as Andrieu. Reddy discussed the role of *ex-post* (retrospective) and *ex-ante* (prospective) analysis in cost-benefit analysis of training. According to Reddy, although *ex-ante* analysis of training programs is useful and indeed necessary for forecasting costs and benefits between alternative training approaches, "cost-benefit studies of training have concentrated on *ex-post* analysis ..." (p. 53), of single projects, and are most useful in conjunction with a qualitative appraisal.

Davis and Morrall (1974) assert that regardless of the applications, the role of cost-benefit analysis remains the same, that is, it explicitly compares the present or anticipated costs of actions with the present or anticipated benefits as long as costs and benefits are expressed in the same units (i.e., dollars and cents). The focus of this study is a retrospective analysis of the costs and benefits of a single project. The absence of a comparison group does not decrease the level of research complexity as much as it does the volume of repetitive actions. The effect is that where costs and benefits of a single service or program are examined, the findings constitute a cost-

outcome description of the program (Drummond, Stoddart, Torrance, 1987). Such studies provide important information needed for assessing priorities for allocating resources to the program as well as the amount of effort needed by institutions and firms to get the best value for its dollar (Drummond & Stoddart, 1985; Reddy, 1979).

A final qualification: retrospective cost-benefit analysis of education and training serves as the basis for prospective analysis and testing the hypothesis driving the prospective analysis (Cohn, 1979; Reddy, 1979).

Cost-Benefit Analysis versus Cost-Effectiveness Analysis

Since there are many conceptual and operational similarities between *cost-benefit analysis* and *cost-effectiveness analysis*, the terms are often used interchangeably. It is important to observe the difference between them.

Cost-benefit analysis and cost-effectiveness analysis are both economic evaluation measures. The obvious similarity in the two terms is the notion of "cost" as an essential ingredient in rendering the evaluative judgement. Cost refers to that which is given up to obtain something else (Levin, 1975; Mills & Drummond, 1985). By assigning resources to one good or service, those resources are not free to be assigned in an alternative way. Popham (1988) likened costs to foregone benefits. By assigning resources to one activity, benefits in an alternative activity are foregone. Mills and Drummond (1985) refer to the value of foregone benefits as the economic definition of costs.

In economic analysis, of which cost-benefit and cost effectiveness analysis form a part, cost refers to total project inputs and processes expressed in money terms (Kaufman, 1988; Mills & Drummond (1985). The total money expenditure of projects is the accounting definition of costs (Mills & Drummond, 1985).

Cost-benefit analysis assumes that outcomes or benefits can be quantified and expressed in money terms (Kober, 1982). The clear-cut assumption is that costs and benefits can be valued at their market prices. Yet, in many programs it is neither possible nor desirable to assign money values to expected consequences (Andrieu, 1977; Cousins, 1979; Reddy, 1979; Thompson & Fortess, 1980). Cost-effectiveness analysis was developed, therefore, to permit some comparison of costs to outcomes where the outcomes are not monetary and cannot be expressed in money terms (Levin, 1975; Quade, 1967).

Cost-effectiveness analysis is an assessment that evaluates a single unit of service outcomes against the total cost of that program (Griffiths, 1988; Mills & Drummond, 1985). Cost-effectiveness measures of training are such measures as cost per hour, cost per student, cost per square foot, etc. Essentially, cost-effectiveness analysis emphasizes delivery system effectiveness and answers the question "What did (will) it cost per unit;" whereas cost-benefit focuses on outcomes further down and answers the question, "Was it (will it be) worth it" (Griffiths, 1988). Models provided by Austin (1978) and Kaufman (1988) suggest that cost-effectiveness and cost-benefit are economic evaluation measures along a program's continuum. Table 6 summarizes the economic evaluation measures.

Table 6
Economic Evaluation Measures

Inputs ⟶	Delivery ⟶	Outputs ⟶	Effects or Benefits
- Costs	- per hour - per sq. ft.	- per trainee	- reduced costs - increased output - improved quality
← Cost →	← Effectiveness →		← Benefit →

Source: Adapted from Austin, 1978, p. 2338 and Kaufman, 1988, p. 32.

Cost-effectiveness analysis identifies the cost per unit of effect. By comparing alternative programs having the same objectives, that is the same outcomes (e.g., auxiliary provided services versus same services provided by a professional), cost-effectiveness analysis will identify the cheapest per unit of effect (Cohn, 1979; Griffiths, 1988; Warner & Hutton, 1980). In situations where different strategies have different objectives thus resulting in differential impacts, cost-effectiveness analysis is not the appropriate analytical tool. It makes no sense to compare the per unit effect between programs employing different efforts to achieve different impacts.

Knowing the least expensive strategy may not be sufficient information on which to base a "go no-go" decision. Cost-effectiveness analysis does not tell us if the objectives are worth achieving economically (Griffiths, 1988). This is the function of cost-benefit analysis.

Cost-benefit analysis goes further than cost-effectiveness analysis. It may be used to compare similar or widely diverse programs (Warner & Hutton, 1988). Griffiths (1988) maintains that by comparing costs with benefits three questions guiding the

decision-making process are answered: (1) whether the strategy provides a net benefit; (b) the level of intervention required to maximize the benefits (for example, it might be more beneficial to target specific age groups for skills upgrading); and (c) which strategy gives the maximum benefits.

To summarize, cost-benefit and cost-effectiveness analyses are analytical tools for evaluating present or proposed interventions. These techniques can aid the decision-maker in allocating scarce resources. Although there are conceptual and operational similarities between the two forms of analyses (both forms of analyses consider costs), to use them interchangeably is misleading because they differ in the way in which they consider consequences. In cost-benefit analysis program consequences are valued in money terms. Conceptually, this permits an assessment of the inherent worth of the program - do benefits exceed costs? Cost-benefit analysis is an analytical technique for comparing similar or widely divergent programs.

In cost-effectiveness analysis, program consequences are not valued in money terms, but rather are expressed in units of effect such as "dollars per trainee." Cost-effectiveness analysis permits the break down of program costs in units of effectiveness thus allowing the comparison of costs per unit of effectiveness between programs having the same objectives. Cost-effectiveness analysis is meaningful only when comparing programs having the same objectives. It is not the appropriate analytical technique for comparing programs having different objectives because program outcomes will differ.

The Cost-Benefit Analysis Framework

The essential operations of the cost-benefit analysis framework are the identification and quantification of costs and benefits. This procedure is complicated by the fact that costs and benefits do not occur simultaneously and therefore may not be expressed in the same dollar units. Thus, another essential element in the cost-benefit analysis framework is the treatment of time in measuring allocative costs and benefits of projects.

White, Wiedman, and Sharp (1983) and Cohen (1985) described the use of cost-benefit analysis in industrial training programs. According to these authors, a cost-benefit analysis must first specify the perspective from which the costs and benefits are being calculated. In general, costs and benefits can be analyzed from the perspective of the individual, the institution or firm, or society (Barsby, 1972; Cohen, 1985; Garbutt, 1969; Rizzuto, 1982; Stromsdorfer & Blalock, 1986; White et al., 1983). Its application, therefore, has considerable variety. Each perspective has its own goals; thus the ensuing list of costs and benefits are not the same for each group. Table 7 on the following page displays the list of costs and benefits from each perspective. For the purposes of the present study, the analysis of costs and benefits was taken from the perspective of the institution or firm.

Table 7
Elements of Costs and Benefits

	Perspective		
	Individual	Institution or Firm	Society
Costs	Cost of training	Cost of providing training	Subsidizing with public funds
	Opportunity costs (earnings foregone during training)	Capital expenses	Opportunity costs (Tax revenue foregone during training)
		Employment costs	
Benefits	Increase in earnings net of taxes	Increased profits	Increase in manpower
	Additional fringe benefits: job satisfaction, etc.	Cost avoidance	Increase in earnings (gross taxes)
		Greater retention of workers	Increase in quality of society

Adapted from Barsby, S.L. (1972). Cost-benefit Analysis and Manpower Programs. Toronto: Lexington Books.

Enumeration of Costs

Human resources development is both an expense and an asset. With regard to expense, it is necessary to recall that internal training is the only way some firms can acquire the pool of labour with which to operate (Garbutt, 1969). The more specific the training is to the firm the more the firm will be expected to impart the necessary training at their expense. The costs to the firm may be defined as the total money expenditures made as a result of training and employing human resources (Mills & Drummond, 1985; Reddy, 1979; Talbot & Ellis, 1969).

The inputs and processes of company training vary from one firm to another. Therefore, it is important that the calculation of training costs includes all the components of each firm's particularized approach. Accordingly, Levin (1975) advocates the "ingredients approach" to identify costs wherein all resource inputs required by the program are identified.

Succeeding authors have presented models for listing the ingredients or inputs of human resources development programs and assigning cost to them. Head and Buchanan (1981) wrote convincingly of the need to inject into corporate training departments the same level of accountability as other corporate bodies. The development of cost-benefit analysis procedures was described as an important foundation for change. The authors presented the "corporate training cost model" as the foundation for the cost-benefit analysis process. The ingredients of the model, accompanied by techniques for calculating each ingredient, were identified as (1) student cost, (2) instructor cost, (3) facilities cost, (4) administrative costs, and (5) instructional development cost. According to the authors, the sum of these five constitutes a reasonable estimate of training costs.

In a much cited article on how to calculate the costs and benefits of a human resources development program, Spencer (1984) categorized expenses as either labour costs or direct costs. Labour costs, or the value of people's time, were identified as either direct labour cost or full labour cost. The distinction made by Spencer between the two is that the former is represented by the individual's salary alone, while the latter is the individual's salary plus fringe benefits (e.g., holidays, vacation, sick leave,

pension costs, dental plans, etc.). Spencer recommends the use of full labour cost in lieu of direct labour cost since it provides the best estimate of how much it actually costs an organization to provide training.

Direct costs in Spencer's model refers to all other costs which are not labour costs such as materials, equipment, facilities, travel, per diem, computer time, etc. Full labour costs added to direct costs will yield the total cost.

Kearsley (1986b) identified four major categories of training costs: (1) personnel costs, (2) facilities expenses, (3) equipment expenses, and (4) the cost of materials. As an aside, Kearsley also includes travel costs and per/diem expenses. To compute the total training costs, one adds up all the cost items relevant to the organization.

In 1986, the National Society for Performance and Instruction recognized Training Cost Analysis by Glenn Head (1985) as the "Outstanding Instructional Communication of the Year." In this landmark publication Head presented the "Training Cost Model" as a series of mathematical formulas, supported by examples and work sheets, for calculating actual training costs on a per course and per student basis. According to the model, student costs + instructor costs + instructional development costs + facilities costs + maintenance costs = total training costs ÷ annual number of students = annual cost per student.

The Training Cost Model is simple in its design but comprehensive in its coverage. Each of the above basic cost factors are broken out into relevant cost items to guide the researcher through the slippery process of deciding on the inclusion (and exclusion) of cost items.

The ingredients of cost analysis vary with each individual case. Models must be customized to meet individual requirements. Kober (1982) has proposed a cost ingredients list for documenting monetary expenditures for training in the health industry. Kober's model categorizes costs as either fixed or variable. Fixed costs are costs which do not change regardless of the number of training programs or the number of students. An example of fixed cost is salaries. Variable costs are costs which increase and decrease with change in volume. The principle is that as volume increases, total variable costs will increase in the same proportion. The following is the list of fixed and variable costs presented by Kober (p. 5):

A. Fixed Cost

1. Salaries, fringe benefits and taxes of full-time staff (consider planning as well as implementation stage)
2. Rent, utilities and janitorial services for staff office space.
3. Clerical assistance and supplies
4. Equipment

B. Variable Cost

1. Training aids - all types of software (films, texts, handouts) and hardware rented for program
2. Rent, utilities, maintenance and security on place used for program
3. Consultant fees and travel
4. Guest faculty fees, travel, room and board
5. Printing and mailing costs of marketing materials and certificates
6. Refreshments
7. Release time for students
8. Evaluation time and materials
9. Unforeseen (margin)

The above list is not meant to be all inclusive, but provides a guide to cost types and their fixed/variable distinctions. Some costs, for example, exhibit characteristics of both fixed and variable costs (Anthony & Young, 1984a). A semi-variable cost is one with a fixed component but then increases with added usage. A good example is

the telephone which can have a set monthly rate for local calls (fixed component) and additional charges for long distance calls (variable component).

The advantage of organizing costs as fixed or variable is that changes in volume activity in each group provide additional evaluative information which is not readily available in the other models. Kober writes that:

> the ratio of variable to fixed costs can be revealing. As a guideline, a 2 to 1 relationship is ideal. If the ratio is much lower due to high fixed costs, an over-staffed, overequipped training department may be indicated. If variable costs are too low, too few participants are in the departments offerings. If the ratio is high because fixed costs are low, the possibility or an ill-equipped or understaffed department exists (Kober, 1982; p. 5).

The various models presented above suggest that costs can be assessed by defining variables that characterize different resources consumed in human resources development. Different authors have different views of how cost variables should be defined and on the importance of certain cost variables. For example, a small set of cost variables are common to all approaches such as personnel cost, facilities cost, equipment and material cost.

A major methodological issue in cost-benefit analysis is the lack of specific guidelines or standardized rules on what constitutes a justifiable cost (Austin, 1978; Bloom, 1986; Dinkel, 1985). This issue is most glaring concerning indirect project costs. Indirect costs are often based on estimates, guesses or conjectures. Estimates are sometimes, but not always, reasoned judgements, and, therefore, it is not possible to place the degree of confidence in them as in direct costs. Guesses or conjectures are opinions of personal judgement based on insufficient evidence and confidence

placed in them is still lower. Opinions of researchers differ sharply on the question of indirect costs of training. Koehler and Slighton (1973) provided a review of the state of the art of cost and activity analysis in the medical school. It was the opinion of these researchers that the cost of all activities which affect training should be included. Johnson and Eady (1972) and Haggart (1972) do not agree. Haggart wrote that it is increasingly acceptable not to allocate indirect costs in order to avoid unknowingly biasing the cost of individual programs. Clearly, there is no consensus on whether or not to include indirect costs, and if so, what degree of confidence is essential to ensure they do not bias the cost of programs?

The question of which and how many inputs should be selected for analysis is problematic in all cost-benefit analyses (Austin, 1978; Bloom, 1986; Dinkel, 1985). Determining costs of programs is not technically difficult if records are adequate and one can define specific inputs clearly. According to Dinkel (1985) what is important is to include as many relevant cost factors as possible to ensure no relevant effects are overlooked.

Enumeration of Benefits

Carnevale and Schulz (1990) state that "human resources development has expense and asset components" (p S-7). The authors go on to say, "for a human resource expenditure to be treated as an asset, it must return benefits to the organization in future accounting periods" (p. S-7). Benefits which accrue to the institution or firm (the employer) are related to the concept of human capital. Human capital refers to

the stock of men and women employed by a firm and whose productive capabilities accrue benefits to the employer. The value of this human capital can be increased through training programs, and the results can be measured as a rate of return on the incremental monetary investment (Dillard, 1982). In economic terms, the present value of a stream of a person's productivity is the appropriate measure of the benefit of investment in human capital. Thus it is assumed that a cause-and-effect relationship exists between the firm's investment in training and the rate of return to the firm (Anthony & Young, 1984b; Dillard, 1982).

Cost-benefit analysis consists of identifying all the benefits that accrue as a result of the program of interest and converting them to equivalent present-day dollars. The main challenge is to identify and quantify program outcomes or "benefits" in financial terms and compare them with program costs. The underlying concept is that the results obtained from human resources development, expressed in money terms, should be commensurate with the resources consumed, also expressed in money terms (Anderson & Kasl, 1982). Theoretically, a program is deemed worthwhile when the dollar value of its benefits exceeds the dollar value of its costs.

The time-honoured way of demonstrating the economic benefits of investment in human capital (human resources development) is to measure the value of additional goods and services produced or the value of cost savings in the provision of goods and services (Carnevale & Schulz, 1990; Kober, 1982; Spencer, 1984; Treasury Board, 1982). The value of additional goods and services is said to be caused by increased productivity; cost savings are caused by more efficient use of resources including

human resources (e.g., work habits). In labour-intensive industries such as the health care industry, where services are the main product, cost avoidance is the major benefit of most company training programs (Caplan & Landekich, 1974; Schaefer & Pizurki; 1984).

Economic benefits may accrue to the employer in other ways. High employee turnover is a major cost item in the health care industry. Employee turnover incurs cost to the employer in the form of separation costs, acquisition or replacement costs and development costs (Flamholtz, 1978). Colton (cited in Kober, 1982) estimates that employee replacement costs are 300 to 700 times the hourly rate. For an employee working 40 hours per week, this represents one to two year's salary.

Human resources development activities which nullify factors contributing to high employee turnover can have economic benefits. Factors which are said to significantly increase staff retention are more skilled practitioners, decreased boredom and anxiety, greater job satisfaction (where dissatisfaction is not the result of poor administrative climate) and improved morale (where low morale is the result of job apathy) (Critical Care, 1988; Suver, 1982).

Many authorities on manpower training policies feel that the evaluation of a program purely in terms of its pecuniary returns is inappropriate and misleading (Chamberlain, 1969; Dymond, 1969; Parnes, 1984; Stromsdorfer & Blalock, 1986; White et al., 1983). They feel that the emphasis on the quantitative and the exclusion of the qualitative threatens to sacrifice worthy programs on "a cross of gold". If the non-economic or intangible benefits of a program are significant they may offset a low

or negative benefit-cost ratio for the economic measurement of a program's benefit. Subsequently, a decision that benefits outweigh cost would be made even if the dollar amounts of tangible benefits were less than cost. Non-monetary considerations should, therefore, be considered as part of a more comprehensive evaluation, since they too provide important information on a program's purposes and objectives (Stromsdorfer & Blalock, 1986).

A low or negative benefit-to-cost ratio of training and utilizing auxiliary health personnel may not be sufficient reason for terminating the program (Drummond & Stoddart, 1985). Political and ethical rationality must be encompassed within economic rationality. Furthermore, when a program in dental care is being delivered to rural, under-served and economically disadvantaged groups, can it be measured with the same yardstick as that provided to better-off urban communities (Mills, 1985a)?

Community health agencies typically provide in-service education to their staff in such areas as health education, counselling, mental health, child sexual abuse, etc. It is virtually impossible to quantify the expected benefits of such process measures (Andrieu, 1977; Berman, 1984; Thompson and Fortess, 1980; Weinstein and Stason, 1977). In situations where it is difficult to express non-economic benefits in terms of their market value, and in projects providing health benefits to disadvantaged groups, the practice is to make the analysis as comprehensive as possible by first quantifying in money terms all costs and benefits measurable in money terms, then qualifying the obtained results in a qualitative manner by describing the relationship between non-economic, intangible outcomes and the program's purposes (Baum & Tolbert, 1985;

Stromsdorfer & Blalock, 1986).

Treatment of Time

Cost-benefit analysis involves a comparison of total costs with total benefits. Since most projects and programs operate over an expanded time horizon, costs and benefits will not occur simultaneously and subsequently do not have the same value. This is corrected by returning all quantifiable costs and benefits to present-day dollar value before they are compared (Blum, 1974; Stromsdorfer & Blalock, 1986; Wood and Campbell, 1970; Yates, 1986).

The techniques for making costs and benefits commensurate to present-day value vary for prospective and retrospective analyses. A prospective analysis, referred to as *ex ante*, is the approach used prior to the implementation of a project to predict what outcomes can be expected over a defined period of time. A retrospective analysis, also referred to as *ex post*, is the technique used to evaluate the costs and benefits which have occurred in the past, after the program has been in operation for some time. A major difference between the prospective and retrospective techniques is that the former is constructed on estimates and assumptions and is generally used to estimate the feasibility of a proposed project by comparing it with an alternative; whereas retrospective analyses are carried out using actual project inputs and outputs and are more often used as a formative evaluation of projects which have already been implemented (Andrieu, 1977; Bryant & White, 1982; Reddy, 1979; Worrall, 1977). According to Reddy (1979), cost-benefit studies of manpower training programs have

concentrated primarily on retrospective studies which were done in conjunction with qualitative appraisals.

A cost-benefit analysis requires three data elements: estimates of the program's cost over time, estimates of the stream of benefits over time, and the interest rate used to discount future costs and benefits into present-day dollars. According to Baker (1978), the discounting procedure is as follows:

$$B=b_0+\frac{b_1}{(1+r)^1}+\frac{b_2}{(1+r)^2}$$

B = Total benefits in present value terms, and where

$$b_o,b_1,b_2$$

are benefits in initial year, after one year, and after two years, respectively, on the assumption that no more benefits are received (in this case) after two years

r = interest rate used to discount

In general the formula is:

$$B=b_0+\frac{b_1}{(1+r)^1}+\ldots\frac{b_t}{(1+r)^t}$$

Where t = lifetime of the project.

Costs are discounted in the same way. Costs which will occur over two years are calculated as:

$$C = c_0 + \frac{c_1}{(1+r)^1} + \frac{c_2}{(1+r)^2}$$

Where

C = Total cost in present value terms, and where

$$c_0, c_1, c_2$$

are costs in initial year, after one year and after two years.

Since the discount rate (r) chosen can make a substantial difference in equating money tomorrow to money today, a major problem in cost-benefit studies is how to determine the proper interest rate for discounting future costs and benefits (Johnson, 1986; Stromsdorfer & Blalock, 1986; Yates, 1986). There are competing theories on how to select the correct discount rate (Drummond et al., 1987; Johnson, 1986; Stromsdorfer & Blalock, 1986). Theoretical support can be found in the literature for each theory. However, several authors (Drummond et al., 1987; Weinstein & Stason, 1977; Yates, 1986) recommend that several rates be used for comparative purposes to obtain a "sensitivity-analysis" and the results of applying each rate be reported. In cases where only a single criterion is needed, Foreyt et al. (in Yates, 1986) recommend that the prime interest rate be used.

In a retrospective cost-benefit analysis where costs and benefits have been assessed over a year or more in the past, a common method for adjusting costs for different year is to divide cost and benefit data from earlier years by an inflation factor for each year, available from government offices, so that the first year of cost and

benefit data collection is the base year for all costs and benefits (Yates, 1986). The results of a retrospective evaluation should be fed back into the decision-making process to yield useful practical insights concerning the allocation of resources and what modification, if any, are needed to improve the program.

Uses and Limitations of Cost-Benefit Analysis

Interest in cost-benefit analysis as a field of study and research has grown rapidly since the early 1960s. The ensuing years have seen extensive development in the literature on the subject. Some authors treat it as some sort of panacea while others attack it as being a somewhat fraudulent if not myopic effort on the part of technocrats to usurp or otherwise mechanise the decision-making process. It is neither. The issue is that of understanding the uses and limitations of cost-benefit analysis and being guided accordingly.

Before examining the apparent limitations of cost-benefit analysis, it is important to identify circumstances under which cost-benefit analysis is likely to be useful. To understand situations which are conducive to retrospective cost-benefit analysis, White et al. (1983) identified three optimal conditions for conducting a cost-benefit analysis: (1) that the program is in the implementation stage; (2) that the impacts and effects are evident and measurable; and (3) that the benefits can be reduced to money terms. To these three a fourth factor may also be added: that the required data be available at the outset (Berman et al., 1986). The fourth factor is important since in order to ensure this requirement is met, cost-benefit analysis must be built into the

project design.

Several proponents of cost-benefit analysis (Anthony & Young, 1985b; Dymond, 1969; Treasury Board, 1982) point out that it imposes a very valuable discipline for assessing projects and programs. Anthony and Young (1984b) and Dinkel (1985) refer to cost-benefit ***analysis*** as a cost-benefit ***way of thinking***. This way of approaching a project yields valuable information concerning the project which might not be apparent otherwise. In assessing a project it is necessary to develop a good understanding and documentation of the project and the environment in which it operates. The process of documenting a project requires a clear understanding of the project's goals (i.e. is there a clear link between project's goals and "benefits"); the project's activities and outputs; the project's intended and unintended impacts and effects; and the relationship between project activities and the impacts and effects. A clearer understanding of these aspects of a project leads to the gathering of more relevant data to arrive at better estimates of costs and benefits.

According to Bootman et al. (1979), decisions on the success or failure of projects are often made on the basis of intuition and personal judgement. Bootman et al. state:

> Cost-benefit analysis - by requiring one to state precise definitions and objectives; to identify criteria for judging results; and to quantify the results of each alternative, formal exposition of alternatives and examination of the effects of assumptions and uncertainties - provides a more solid basis for decision-making (Bootman et al., 1979, p. 131).

Prest and Turvey declare:

> An important advantage of cost-benefit study is that it forces those responsible to quantify costs and benefits as far as possible rather than rest content with vague qualitative judgements or personal hunches (Prest & Turvey, 1965, p. 684).

The aim of cost-benefit analysis is to compare project cost with project benefits using a common measuring rod: dollars and cents. The underlying concept is that for a project to be deemed worthwhile, allocative benefits associated with the project should exceed the allocative costs. Yet, the ability to put all benefits in dollar terms is difficult if not impossible (Anthony & Young, 1984b; Cousins, 1979; McMillan & Schumacher, 1984; Reddy, 1979; White et al., 1983). In the words of Anthony and Young:

> There is no important problem in which *all* relevant factors can be reduced to numbers. Cost-benefit analysis will never provide the complete answer to any important problem (Anthony & Young, 1984b; p.316; emphasis in the original).

Cost benefit analysis is only one tool for decision making and should not be used as the "sole source" to arrive at a decision concerning one issue. For example, a low or negative benefit-to-cost ratio on the training and utilization of auxiliary health personnel may not be sufficient reason for terminating the program, but it can provide information on reallocation of resources within the program to increase program efficiency. Furthermore, cost-benefit analysis does not necessarily take into account whose costs and whose benefits are being counted (Green and Lewis, 1986). For example, as pointed out earlier, when a program of dental care is being delivered to rural, under-served and economically disadvantaged groups, can it really be measured with the same meter as that provided to better-off urban communities (Mills, 1985a)? Subsequently, there are obvious ethical and political risks in making decisions on program fate purely on the result of cost-benefit analysis. Conversely, the most economically efficient project is not necessarily the most politically or socially

efficient.

Cost-benefit analysis does not provide all the information needed for a good decision. Its role is to find trade-offs between quantitative and qualitative information. If decision-makers are presented with such quantitative and qualitative factors, they will have the best possible information on which to base their decisions.

Social Cost-Benefit Analysis

When speaking of cost-benefit analysis of health programs, of which the training and utilization of auxiliary health personnel is an element, there is usually a strong tendency in some quarters to leap to the conclusion that the study will compare the cost of a specific health intervention with the benefits accruing to society or the r ient. In the view of this researcher it is worthwhile to discuss social cost benefit analysis and the reasons why it is not the approach taken in the present study.

In general, costs and benefits can be analyzed from the perspective of the individual, the institution or firm, or society (Barsby, 1972; Cohen, 1985; Garbutt, 1969; Rizzuto, 1982; Stromsdorfer & Blalock, 1986; White et al., 1983). For the purpose of this study, the analysis of costs and benefits is from the perspective of Health and Welfare Canada or the institution. A cost-benefit analysis from the perspective of the individual would be an assessment of the costs incurred and benefits accruing to the learner (the student) for having invested in his or her education. A social cost-benefit analysis would assess the costs and benefits of a program to society.

Bearing in mind that benefits must be calculated in financial terms, social cost-benefit analysis must identify quantifiable benefits accruing to society. Popkin, Solon, Fernandez, & Latham (1980) described social benefits as "the sum of all the expected private benefits plus any additional benefits accruing to society" (p. 208). Cost-benefit studies of health programs traditionally assess private benefits in "human capital" fashion (Fairbank, 1980; Dinkel, 1985; Popkin et al., 1980; Wang'ombe, 1984). The human capital method measures private benefits by assigning monetary value to health improvement in the life of individuals. The tendency has been to use either measures of future earnings of a worker or the value of time lost from work in terms of lost wages as a measure of private benefits (Berman, 1984; Fairbank, 1980; Weinstein & Stason, 1977). The assumption behind this approach is that society (an aggregate of individuals) would be denied the potential consumption of goods and services in proportion to lost earnings (Weinstein & Stason, 1977).

Health professionals and health economists are uneasy with an approach which requires assigning different dollar values to different individuals. Such measures are biased in favour of groups or individuals who participate in the work force - and further biased in favour of white collar workers. There is an additional bias in favour of men in societies where the labour force is predominately male. Finally, this approach is strongly biased against the unemployed, the elderly, and children.

The convention of using the productive capacity of a society or wage value to measure private benefits is deceptive when applied to areas of high unemployment. Indian and northern communities of Canada have large pools of surplus labour where

improvement in health status could be unrelated to productivity and employment earnings.

An alternative approach to the human capital convention is "willingness-to-pay" (WTP) as an index of benefit. In the "willingness to pay" approach, the value of life is determined by the amount the individual is willing to pay to avert morbidity, mortality, or disability (Dinkel, 1985; Popkin et al. 1980). Sugden and Williams (cited in Campen, 1986) describe the underlying principle of valuation as a 'market' one:

> we are valuing how much people *would be willing to pay* for goods if, by some means or other, they were called upon to pay for what they consume (p. 29; emphasis in the original).

According to Campen (1986),

> The increase (or decrease) in an individual's welfare that would result from any project is indicated by the maximum amount that the individual would be willing to pay (or the minimum amount the individual would be willing to accept as compensation) to have the project happen rather than not happen (p. 29).

He further adds,

> The impact on an individual's welfare ... is best measured by the individual's WTP; this provides an exact measure of the change in an individual's welfare, as valued by the individual (p. 29).

The simplicity of this approach may be misleading. Several writers in the literature state that the actual measurement of "willingness to pay" presents great difficulty (Campen, 1986; Reddy, 1979; Wang'ombe, 1984). Campen provides a concise discussion of the "willingness to pay" approach to cost-benefit analysis. Wang'ombe used the "willingness to pay" approach to compare costs and benefits of a community-based health care project in Kenya.

At present there appears to be good cause for arguing against the "willingness to pay" approach to dental care in Indian and northern communities since standard market conditions do not exist in most of these communities. Non-Insured Health Benefits guarantees to status Indians and Inuit health-related goods and services not covered on a universal basis by provincial health programs or a third-party medical insurance plan. Dental care is a major component of the Non-Insured Health Benefits package. "Willingness to pay" is assumed to be absent since the current Indian Health Policy guarantees to status Indians and Inuit of Canada basic dental care paid on their behalf by the Federal Government.

Quality of Care and Cost-Benefit Analysis

Breslow (1980) and Angevine (cited in Dunning, 1979) claim that the development of new types of health personnel and incorporating them within the health care system is one way of increasing the quantity of care without adversely affecting the quality of care. This means that the identified tasks and procedures of new types of health personnel must be performed in conformity with recognized technical standards.

Berman (1984) refers to quality of care as "the performance of treatment tasks according to the necessary technical specifications" (p. 69 f). Berman et al. (1986) later identified three factors affecting the performance of treatment tasks: (1) knowledge; (2) skills and techniques; and (3) supplies and equipment. To these may be added a fourth factor which is an extension of the identified three: active practice or regular use (Habicht, 1979). Knowledge and skills are strengthened and further

developed with regular usage and good supervision. Regular usage implies the availability of necessary supplies and equipment.

Avedis Donabedian (1969), dean of the "quality-of-care" field, outlined three constructs for assessing quality of care. These are labelled "structure," "process," and "outcome." The assessment of structure refers to an examination of facilities (e.g., hospital accreditation), personnel (e.g. board certification), and organizations against a predetermined standard. The assessment of process refers to such operations as direct observation of procedures (e.g., observing what care givers do), evaluating the outputs (e.g., quality of dental restorations), and examination of patient records to evaluate patterns of care. Outcomes refer to measures of health improvement which are said to be linked to specific kinds and quality levels of service (Baker, 1978). Outcomes of the dental therapist program may include reduced discomfort, avoidance of days loss in schooling or work, averting worse dental morbidity since most dental diseases are not self-limiting, and improvement in the self-image of the patient. This approach to the measurement of quality is considered by many to be the most difficult because outcomes are additionally influenced by intervening factors outside primary dental care (Baker, 1978; Borgiel, Williams, Anderson, Bass, Dunn, Lamont, Spasoff, & Rice, 1985; Brook & Lohr, 1985; Sackett, 1980).

The observations of Berman et al. and Donabedian lead to the conclusion that the quality of care of the dental therapist program depends first on the effectiveness of the teaching/learning process and later on the efficacy with which this learning is brought to bear in patient care.

Most quality of care evaluations are of the process type because they are closer to health outcome than structural measures, are easier to document than outcomes, and are reliable predictors of outcome (Sackett, 1980). Process evaluation may appear in different forms but all can be classified into three types: (1) direct observations; (2) observations of results; (3) review of patients' dental records (De Jong & Dunning, 1970; Dunning, 1979).

Quality of care studies utilizing direct observation of procedures allows the appraisal of dental services (procedures and techniques) at the time they are delivered. Observational studies are extremely difficult and time-consuming to carry out. Direct observation of procedures is most frequently found in training programs where clinical instructors scrutinize student performance at each step in a clinical procedure. Thus, quality of care begins during the teaching/learning process where trainees obtain instruction and supervised practice to ensure they attain and maintain acceptable standards which are considered desirable and adequate.

The evaluation of the technical excellence of the outputs of restorative dentistry provides useful indices to the quality of dental treatment. According to De Jong and Dunning (1970), despite the appeal of this approach, it is only practical and economical when carried out on small scale patient samples. Even then it does not provide information on such matters as the extent to which carious dentin was removed, proper sterilization, cleanliness, effective radiation-hygiene, protecting the pulp and periodontal membrane, and patient management techniques (De Jong & Dunning, 1970; Dunning, 1979; Striffler, cited in Soricelli, 1971).

Quality of care studies utilizing direct observation of procedures and/or observation of results are difficult, time-consuming, long range, and require trained personnel to carry out, making them prohibitively expensive (Baker, 1978; Corbett, 1979; Deets & Blume, 1977; De Jong & Dunning, 1970; Oliver, 1984).

A review of patients' dental records is the least expensive and most practical means for assessing the process of dental care. By auditing the records one can identify certain quality of care indicators. Quality indicators refer to tracer conditions or service patterns found in patient records that indicate quality. A review of patient dental records would reveal the presence or absence of acceptable patterns and how certain tracer conditions were handled. This approach to the use of process measures of performance has won wide acceptance (Brook & Lohr, 1985; Dunning, 1979).

According to De Jong and Dunning (1970), "[Quality indicators serve] to establish a [dental therapist's] pattern of treatment in specific categories of services that patients of a certain age or sex may be receiving ... "(p. 225). The assumption is, according to Dunning (1979), that a certain degree of uniformity in dental needs exists among patients of certain ages in certain localities and cultural groups. A review of patient dental records in these settings would reveal the presence or absence of desirable patterns of practice, thus providing an index to the quality of care delivered in that setting (Sackett, 1980).

Frequency distribution of all the services a dental therapist has provided his or her patients in specific categories of service for a given period of time and the dental therapist's ratio of restorations to extractions would be compared to national and

regional averages (De Jong & Dunning, 1970). The ratio of restorations to extractions is calculated by dividing the total number of restorations by the total number of extractions performed by a dental therapist during a given period of time. A steady trend towards fewer extractions relative to fillings is considered a valid indicator of quality care. De Jong and Dunning assert that "the results have been shown to correlate excellently with the quality of services provided to patients " (p. 225).

Another service pattern indicating quality of care but about which there is very little in the literature is the ratio of restorative to preventive work. This ratio is influenced by the shift from extractions and restorative work to preventive work. This desired natural shift in services suggests that the dental health in the community is improving, which represents the entire *raison d'être* of the dental therapist program.

The limitation in the use of statistical analysis (i.e., the two ratios) of patient records is that dental therapists who deviate from the desired trend are not necessarily delivering inferior dental care. There are several factors which may adversely reverse the trend such as an influx of new people having unmet dental treatment needs.

The maintenance of quality of care through personal competence is said to be the personal responsibility of all care givers. Continuing education is thought by many to maintain and improve quality of care of health workers (Abbatt & Mejia, 1988; Fisher, 1971; Soricelli, 1971; Turner, 1986; Young, 1983). Abbatt and Mejia (1988) define continuing education of health workers as "all the experiences, after initial training, that help health care personnel to maintain or learn competencies relevant to the provision of health care" (p. 9).

Although there is little empirical evidence documenting the effectiveness of continuing education (del Bueno, 1977; Lloyd & Abrahamson, 1979; Oliver, 1984; Rizzuto, 1982; Sparks, 1985; Young, 1983), in the past 15 years the idea of continuing education as a means of preventing obsolescence of practice has gained in popularity (Abbatt & Mejia, 1988; Fisher, 1971; WHO, 1979). Abbatt and Mejia (1988) claim continuing education is "the most important way of adapting the performance of health workers to meet the needs of the current situation or of some newly developing situation" (p. 9). This implies continuing education has an important role in strengthening and extending quality of care by increasing the "what" and "how" of current dental knowledge and practice (Abramowitz & Mecklenberg, 1972; Soricelli, 1971).

The relationship between quality of care and cost benefit analysis can be explained in several ways. First, choosing among alternative forms of care, when they differ in abilities and costs, requires knowledge of the expected benefits of those forms of care. In that regard, a rational argument can be developed against the validity of comparing any aspects of the cost or benefits of care provided by auxiliary health personnel with costs or benefits of care provided by professional health personnel (Habicht, 1979), since there is a subtle suggestion that we are not speaking of the same standards of care. For example, comparing the economic value of auxiliary produced outputs with the economic value of outputs produced by professional dental practitioners on the same service objectives presumes that auxiliary produced outputs are comparable in quality and consequences to clinic visits with a professional practitioner; that is,

auxiliary health workers produce clinical effects equivalent to the professional health worker. This assumption should be tested.

The second way in which quality of care is linked to cost-benefit analysis is demonstrated when dental services are provided repetitively and inappropriately. Repetitive treatment, according to Abramowitz and Mecklenberg (1972) "can waste the [dental therapist's] time and deny the time that would otherwise be available for additional people" (p. 91). Acceptable levels of quality of care ensure that effort has not been lost in providing services inappropriately, resulting in unnecessary additional services and in possibly inflated productivity figures leading to a false positive cost-benefit ratio.

The third and final association between quality of care and cost-benefit analysis is related to the ratio of extractions to restoration and the ratio of restorations to preventive work. These two ratios collectively represent the desired natural shift from more extractions to more restorations to more prevention. This shift will also result in changes in resource use arising from treatment. Drummond and Stoddart (1985) state that such change will result in resource savings, if the patient's improved oral health will result in lower future consumption of services including services of specialists. This, according to Drummond and Stoddart, is one of the main arguments for preventive measures.

Applications of Cost-Benefit Analysis to Training and Utilization of Auxiliary Health Personnel

Most of the cost-benefit work to date in human resources development outlines

various methodologies and requirements to carry out economic analysis of employee training (Cohen, 1985). A number of the methodological works in cost-benefit analysis have pointed out the difficulties in doing cost-benefit studies (Dinkel, 1985; Drummond & Stoddart, 1985; Mills, 1985a & 1985b; Reddy, 1979). Theoretical and practical solutions for applying cost-benefit analysis to human resources development have been developed by Head (1985); Head & Buchanan (1981); Kearsley (1982); Kearsley (1986a-b-c-d-e); Kober (1982); and Spencer (1984).

Recently, Carnevale and Schulz (1990) have produced a comprehensive and well-written article putting the case for economic evaluation of investment in training on the grounds of its usefulness to corporate managers and managers of training as an evaluation technique to answer questions about the economic value of human resources development. Their article describes a rationale and approach for cost-benefit analysis of employee training programs. The first part provides a framework for viewing and understanding economic accountability and human capital formation. The second and third parts examine the weakness of traditional management accounting systems and propose a new structure "the consensus accounting model" for linking traditional practices with desired outcomes. The fourth part of the guide examines the evaluation framework, design and reports. Evaluation design is presented from the perspective of experimental design and control to lend scientific integrity to the obtained results. The document concludes with an examination of current evaluation practices of major firms.

Although cost-benefit analysis is a widely discussed method for analyzing and

evaluating employee training, there is a shortage of thoroughly documented applications in the literature (Carnevale & Schulz, 1990; Cohen, 1985; Drucker, 1985; Hawthorne, 1986; Swanson & Geroy, 1984; Tosti, 1980). Bloom (1986) finds this is not surprising considering that discussions of cost-benefit analysis are not often part of traditional research curricula. Even specialized courses in program evaluation may not include this field of research.

The on-line data search plus the examination of two comprehensive annotated bibliographies on health economics (Culyer, Wiseman, Walker, 1977; Griffiths et al., 1980) revealed there is a substantial paucity of well documented empirical studies specifically designed to test the hypothesis that the benefits which accrue from the utilization of auxiliary health personnel justify the training and operating costs of the scheme, a surprising gap when the cost of health services delivery is such a sensitive issue in all countries. The few references which were identified, come up with reports in the same general range, that the benefits obtained through auxiliary health worker interventions can justify the costs of training and employing them. Martin and Newman (1973), for example, described the costs and benefits of a program designed to train and utilize student health-aides at the University of Nebraska to reduce pressure on the University health centre. The study was based on the reports filed by 82 health-aides during the spring semester of 1971 and 135 health-aides during the fall semester of 1971. The student health-aides were trained to deal with minor health and first-aid problems, act as sources of health information and to refer more difficult cases to the health centre. They worked out of dormitories and fraternity and sorority

houses and were paid as members of the health centre staff. The study revealed that health aides were able to effectively deal with most problems at the first level of contact, thus reducing the clinic load at the health centre. It was found that the monthly salary paid to the health aides translated into a cost of $1.12 per visit to the health aide, as compared to the average direct cost per outpatient visit at the health centre of $3.03. This figure does not include such indirect cost savings as medical records, administration, and laboratory and x-ray services. Since part of the remuneration of health aides included one semester hour of academic credit for each of two semesters they worked, the salary and overhead cost of the instructors were not considered in that their time was considered as generating academic credit. The authors conceded that the amount of time expended by the three instructors (who also provided support and supervision to the health aides) exceeded the time needed for a one-credit-hour academic course. The implication is that there may be a trade-off between the additional time expended by the staff and the additional savings from avoided indirect cost of student visits to the health centre. The authors concluded that the program is justifiable based on dollar costs alone.

Hu (1976) attempted to define and quantify the costs and benefits of the "barefoot doctor" service in the People's Republic of China. Barefoot doctors and public health workers received training in the treatment and management of minor illnesses and accidents occurring in the production brigade. Hu identified and quantified three costs: (i) the costs of providing the training for barefoot doctors, (ii) the costs of receiving the training (cost of time lost by trainees by being absent from the

production process), and (iii) the costs of providing the services (time lost by barefoot doctors from production). The monetary estimation of benefits was calculated in two ways: (i) reported reduction in working days lost, and (ii) amount of travelling and waiting time saved because of the immediate availability of the service. Hu concluded that the benefits of the barefoot doctor scheme outweighed the instructional costs and the cost of the outputs foregone for being absent from work in order to train and later to treat. Hu's conceptualization of the study is appealing but the study suffers due to the fact that costs and benefits were compiled primarily from secondary sources of information such as newspapers.

Wang'ombe (1984) investigated the costs and benefits of a community-based health care project in Kenya in which 96 part-time community health workers were trained for two months and deployed in two regions of Western Province. Each community contained an average of 137 households. The community health workers were trained to act as first contact providers of health care and promoters of selected health, sanitation and nutrition practices. They were paid a part-time salary by the community and were additionally allowed to charge a token fee for treatment from each client. The cost-benefit analysis was undertaken using the "willingness to pay" approach to compare project costs with project benefits. In this study "willingness to pay" was a measure of the demand for service. In keeping with the requirement that benefits be quantified in money terms, the benefits were quantified in terms of average cost to the users. The assumption was that more accessible services at lower cost would generate a consumer surplus accruing to the community. Consumer surplus is

the effect of a fall in average user costs and rise in the utilization of the project services. Based on a large Net Present Value and cost-benefit ratio, Wong'ombe concluded that the benefits accruing from the utilization of community health workers were far in excess of the costs of training and employing community health workers. He further contends that the results of the study weigh strongly in favour of decentralization of primary health care on a similar basis to the rest of the country. The study, on the other hand, did not compare the quality of care provided by community health workers with that of the service delivery mode which it replaced.

Kushner (1976) researched the costs and benefits of nurse practitioner training. In his study the economic returns to the program were assessed from the viewpoint of (i) the nurse, (ii) society, and (iii) the government budget. For each perspective the enumeration of costs and benefits included both direct costs and benefits and indirect costs (opportunity costs) and benefits. Sensitivity analysis was conducted using discount rates of 5, 7, and 10 percent. Kushner concluded that, using a discount rate of 7 percent, the nurse practitioner training would be profitable to the nurse after two years, the time required to pay back the initial educational cost. The nurse practitioner training was also found to be cost-beneficial to society, and more so than to the nurse. The nurse practitioner program was found to be favourable to the government (in terms of increased tax revenues and decreased welfare and unemployment insurance payments) only if the nurse remained in the labour force for 30 years.

The literature review produced several articles on the costs and benefits of employing dental therapists and expanded duty dental auxiliaries in private dental

offices (Abramowitz & Berg, 1973; Pelton et al., 1973; Redig et al., 1974; Romcke & Lewis, 1973; Rosenblum, 1971; Soricelli, 1972). Each of these studies reported that the cost of employing dental therapists was offset by the increased economic benefits obtained. Several of the studies reported on the marginal productivity associated with varying amounts of dentists and dental therapists employed in the production process. In general, the consensus in the studies were that although office expenses did increase with the use of dental therapists, the same dentists were also able to increase substantially the amount billed to patients because more dental services were performed. In most cases the net income of the dentist increased from 25 to 45 percent. The dentist also worked fewer hours.

Summary

In this chapter the literature on cost-benefit analysis was reviewed with reference to the costs and benefits of employee training. The enumeration of costs is based on the "ingredients approach". The ingredients of cost analysis vary with each individual case. The enumeration of benefits is from the standpoint of increased revenue, decreased or avoided expenses, and intangible benefits. Although there is extensive literature on the methodological considerations of cost-benefit analysis, there is a paucity of empirical studies on the costs and benefits of employee training.

Cost-benefit analysis of health programs, of which the use of auxiliary health personnel are a part, are often assumed *a priori* to compare the cost of health interventions with the benefits accruing to society (social cost-benefit analysis). This

approach works well in environments where open market conditions prevail. The present chapter placed the study in the context of a welfare state which does not readily lend itself to social cost-benefit analysis.

In the delivery of health care programs by auxiliary health personnel, quality of care is an important consideration. Lower levels of quality resulting in wastage add to the financial burden of the program. Higher levels of quality are program benefits which should be measured qualitatively and quantitatively.

Three applications of cost-benefit analyses of the training and utilization of auxiliary health personnel in three different countries were reviewed. The three references arrived at the same general conclusion: that the benefits obtained through auxiliary health worker interventions can justify the costs of training and employing them.

CHAPTER IV

CONCEPTUAL AND METHODOLOGICAL FRAMEWORK

The preceding chapter has established the ground work for an economic analysis of costs and returns for investment in a program aimed at the development and employment of human resources. In general, benefits should measure the value of additional goods or services produced or the value of cost savings in the provision of goods and services, while cost should measure the value of real resources consumed to obtain the benefits. Thus an input/output framework is established where project costs represent the inputs used to produce a specified set of final outputs, or benefits.

Input/output analysis is an operations research tool that looks at complex mixtures in terms of a few general variables. The purpose of this chapter is to establish the conceptual and methodological background guiding the analysis by (a) describing the relationship between operations research and input/output models and cost-benefit analysis and (b) establishing the analytical framework for the study using an input/output model.

Cost-Benefit Analysis and Operations Research

Operations Research Defined

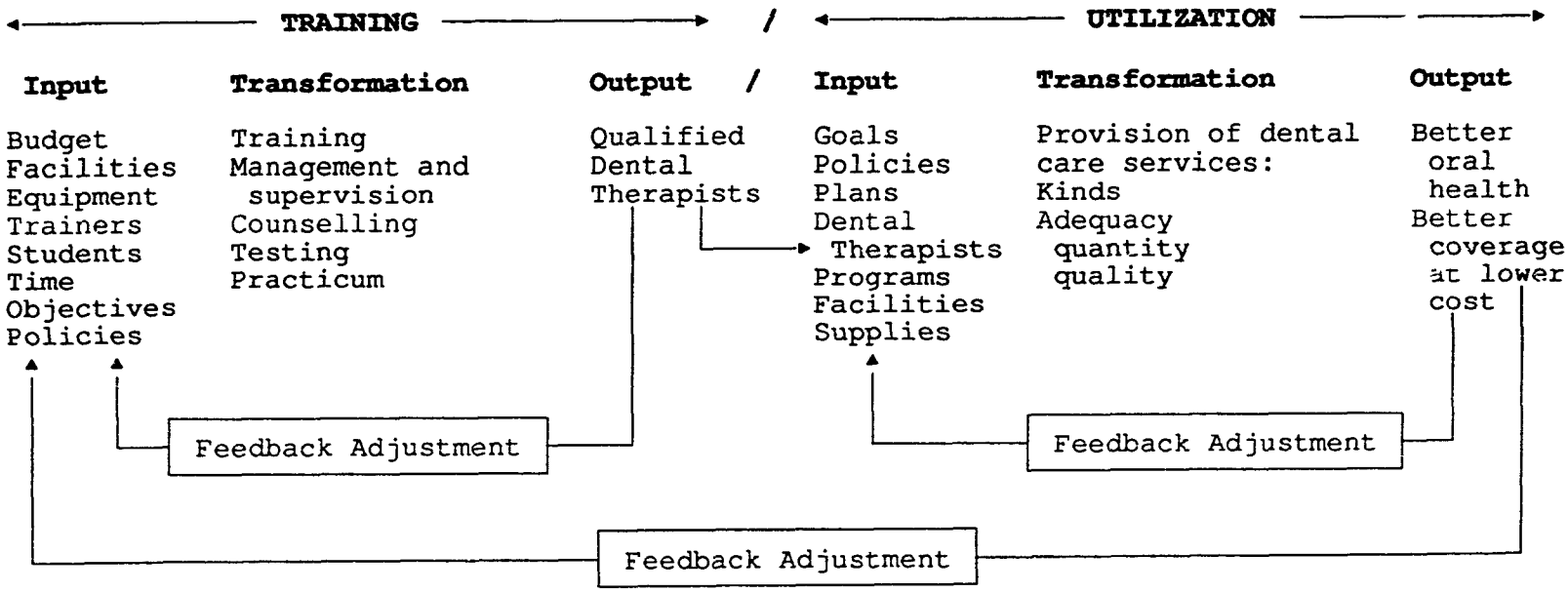
Operations research is applied research directed at problem analysis and problem-solving (Ackoff & Sasieni, 1968; Reynolds, 1986). The principal objective of operations research is to help policy makers and program managers find solutions to

operational problems by stating the problem in mathematical expressions and by using models (Drummond et al., 1987; Reynolds, 1986). It is the use of applied mathematics and the use of models to analyze problems and develop solutions which distinguishes operations research from other types of research. Some of the typical problems addressed by operations research techniques are: allocation of resources; waiting lines; storage, failure and replacement of equipment, etc. The solution to any of these problems will assist managers in making choices. Since the focus of cost-benefit analysis is decision-making and problem-solving, cost-benefit analysis is a logical extension of operations research (Drummond et al., 1987; Williams, 1973).

As an extension of operations research, cost-benefit analysis borrows from the engineering method which is based on an examination of the relationship between the inputs of some productive process, the output from the process, and the transformation process whereby inputs are transformed into outputs. An example of the relationship between input and output in a scheme to train and utilize dental therapists is depicted in Figure 7.

The input is the ingredients of the program. It consists of human and material resources and is the locus for identifying and measuring the operational cost of the program. The transformation is the organization of inputs into activities and services in order to produce the output. The output may be specific effects expressed in appropriate natural or physical units (Austin, 1978; Drummond et al., 1987) which in the first instance are "qualified dental therapists". The output may also be expressed as an outcome or benefit (Kaufman, 1988) which is quantifiable and measurable in

Figure 7
Input/Output Relationship in the Dental Therapy Program



money terms, which in the second instance is better coverage at lower cost. The feedback adjustment allows data on the output to influence future operations of the program. The model makes clear the implicit causal relationship between input and output.

Cost-benefit analysis is said to demonstrate cause-and-effect in an input/output model (Anthony & Young, 1984a) where money factors are important manipulated variables. As in all cause-and-effect relationships the manipulation of one variable (say money) will affect the outcome. However, it is not feasible to experiment directly with project funds since the intentional experimental manipulation of money variables in a project can have disastrous effects. Research that does not involve actual experimentation must be found. What is needed is a research tool that can model the system under study and manipulate its components. It is the use of models to analyze problems and to develop and test solutions that distinguishes operations research from other types of research.

Operations Research Models

A model is a simplified representation of the real world, that is, it is a reproduction used to describe, explain, or predict elements in the referent system (Andrews & Goodson, 1981). Anthony and Young (1984b) contend that

> ...all benefit/cost analyses at least imply that there is an underlying model that describes both the essential variables in the situation being studied and the relationship among them (p. 321).

The system which is the focus of the cost-benefit analysis is thus "modelled" at

some level of simplification, and the effects of various changes in controllable variables or inputs such as money, equipment, human resources, are then explored with respect to the outcomes (benefits) of the system (Williams, 1973). Cost-benefit analysis is, thus, a natural extension of operations research.

All existing models may be classified as either mental, physical, or symbolic (Chorny, 1973). Mental models incorporate what is known and thought about a particular social system. Physical models are concrete replicas of a system constructed from tangible material, the most outstanding characteristics of which they try to reproduce. Symbolic models utilize language and/or symbols to describe the system's operation.

Operations research makes use of all three categories of models to analyze problems and test different solutions. Three types of models most often used in operations research are graphic and mathematical (symbolic models), and heuristic (mental models) (Reynolds, 1986). Graphic models may be in the form of charts, diagrams, flow charts, networks, and decision trees to name but a few. Graphic models would be used in cost-benefit analysis to depict the causal relationship between a project's activities and services and its costs and benefits.

Mathematical models are those which utilize mathematics in any of its branches to illustrate relationships. In simple regression analysis the regression line formula ($Y = a + bx$) is an example of a mathematical model. It is also an example of statistical analysis used in operations research. Other mathematical models used extensively in operations research are linear programming models to solve resource allocation

problems (i.e., allocation of human resources for maximum results within given constraints); queuing models to solve waiting line problems (e.g., how many customs officers are needed to clear foreign arrivals at Toronto International Airport during peak hours). Other types of mathematical formulae include cost-benefit and cost-effectiveness analyses.

Heuristics represent a third type of model used in operations research. The word "heuristic" comes from a Greek word meaning "serving to discover" (Blum, 1984). It is currently used as an adjective in the sense of "guiding discovery" or "improving problem solving" (Smith, 1987). Heuristic models are used with both quantitative and qualitative data. Many of these models are structured ways to process opinions and expert judgement needed to understand and solve problems, but which are often difficult to quantify. Brainstorming is one heuristic technique familiar to most people. Another heuristic model is Nominal Group Technique: a process by which excellent problem awareness may be elicited from a large group in a short time by obtaining participation from every attendee, avoiding group control by dominant individuals, and extending the quality and quantity of contributions of group participants (Blum, 1984).

The models used in cost-benefit analysis are both graphic and mathematical. The next section develops the model used for the analysis in this study.

An Analytical Framework for Assessing the Costs and Benefits of Training and Utilization of Auxiliary Health Workers

This section develops and describes the analytical model for use in this study. The framework adopted in this study is drawn from the literature on human resources

accounting and from Roger Kaufman's Organizational Elements Model, and is modified in accordance with specifications related to the training and utilization of auxiliary health personnel. The conceptual framework consists of inputs (measures of cost), process variables (training and employment) and outcome measures (quantifiable benefits).

Cost-Benefit Analysis Methodology

In recent years an enormous body of literature has been generated on the theory and application of cost-benefit analysis. The profusion of explicative literature has contributed as much to confusion as to enlightenment (Bloom, 1986; Dinkel, 1985; Drummond & Stoddart, 1985). This disparity in the literature is one of multiple etiology and indicates that the techniques of cost-benefit analysis are still in a state of evolution (Birch & Donaldson, 1987; Dinkel, 1985; Treasury Board, 1982), that there is considerable variability in its application (Mills, 1985b; Rothenberg, 1975; Zöllner, 1985), and that there are methodological controversies as well as flaws in some of the literature (Dinkel, 1985; Drummond & Stoddart, 1985, Mills, 1985b; Zöllner, 1985).

A successful cost-benefit analysis requires that all steps in the process be identified and planned in advance. While there is no universally accepted analytical framework or set of procedures, there exists a rough consensus regarding methodology (Drummond & Stoddart, 1985; Zöllner, 1985). A number of basic models have been developed for conducting cost-benefit studies. These analytical frameworks consist of an ordered progression of steps that must be accomplished in the analysis. The steps

used to conduct the cost-benefit analysis in the present study were developed by Griffiths (1988). It bears conceptual and operational similarities with other methods in the literature, with the added distinction of integrating the method and application of cost-benefit analysis and cost-effectiveness analysis into a single framework with conceptual and procedural clarity. Griffiths' summary of steps of economic analysis is illustrated in Figure 8 on the following page.

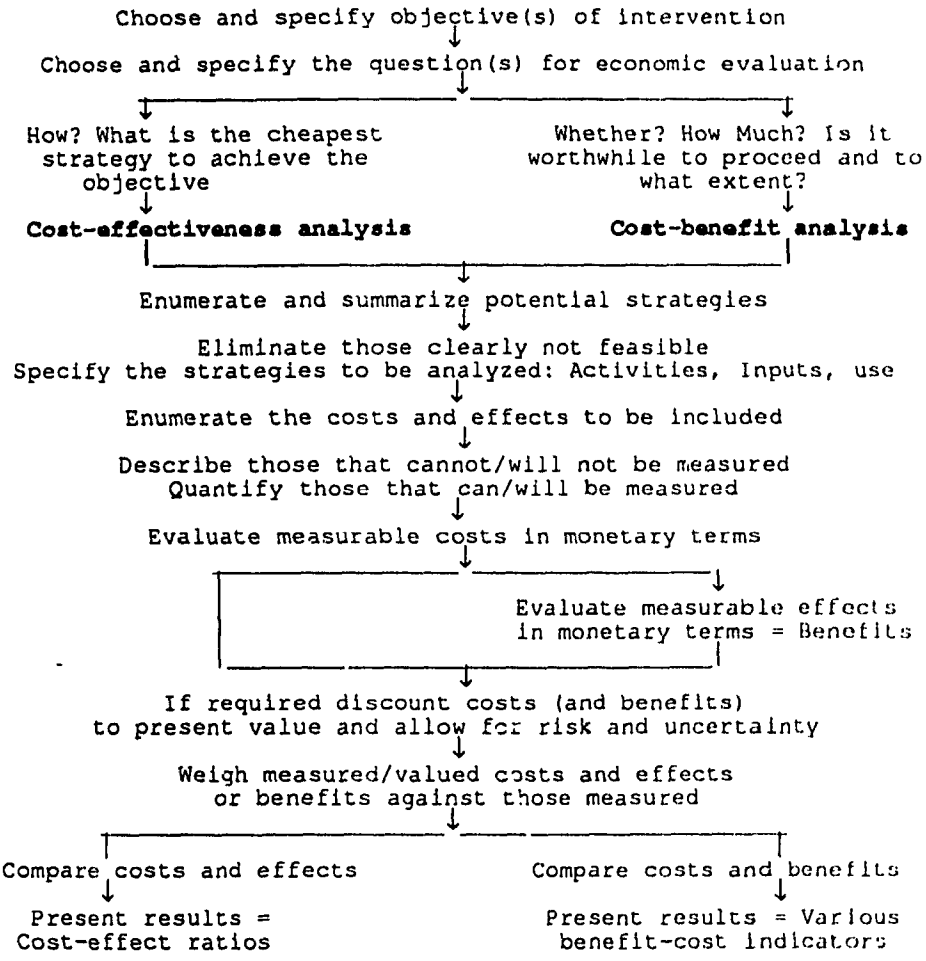
The following sections will clarify the matter of the objectives of the intervention and the enumeration of potential strategies in terms of the present study.

Specification of the Objectives of the Intervention

The first important step in conducting a cost-benefit analysis of any auxiliary health worker training and utilization scheme is a clear understanding of the mission of the program and its mission objective (Kaufman, 1988). According to Kaufman, a mission is an overall job that is to be accomplished; a mission objective states the mission in measurable performance specification. The mission and the mission objective lead to an enunciation of the program's operational objectives which in turn will determine how the project's costs and benefits are defined.

Regardless of the function and duties of auxiliary health personnel, their utilization in the health care system is generally attributable to the public's inability to get adequate access to health services, and to the rising cost of health care (Berki, 1973; Berman et al. 1986; Smith, 1987). In many parts of the developing world there is an insufficient output of new professionals in the health field while the existing ones still continue to concentrate in the principle cities. Although in other countries overall

Figure 8
A General Summary of the Steps of Economic Evaluation



Source: Griffiths, A. (1988). Cost-effectiveness and cost-benefit analysis of health services: the methodology and its application. Health Policy, 9, 251-265.

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ratios of health professionals to population do not support the idea of crisis, there does exist a problem of the right kind, doing the right things, in the right place, at the right time. In short, there is a maldistribution in location and speciality, resulting in less than efficient productivity.

Along with concern about the production and maldistribution of health professionals, there is a growing concern about the cost of health manpower education and utilization, and that this cost is not commensurate with improvement in health status (Mejia, 1980). It has been estimated that between 60% and 80% of any health budget is spent on health manpower alone of which over 70% is just for the cost of doctors and nurses (Mejia, 1980). In a review of poverty, development, and health policy, Abel-Smith and Leiserson (1978) stated that,

> The cost of educating and training [health professionals] is not just the cost of providing schools, universities, or training centres but the cost of students and trainees learning instead of working. During full-time education, the economy loses because both the trainer and the trainee are making no contribution. The community is waiting to obtain the advantages of trained (or better trained) staff (p.44-45, parenthesis in original).

The same authors developed a hypothetical example to compare the costs of a five-year medical education program with a two-year training program for medical auxiliaries. They concluded that about 8 medical auxiliaries can be trained for the cost of training one physician. When such costs are added to that of paying the physician's salary, the authors raise the following question: "Does the greater contribution of the doctor justify the higher training cost as well as the higher salary" (p. 45)?

In western countries one of the most important multipliers of health costs is the number of health professionals (physicians, dentists) practising in the system. The costs attributable to these health professionals are not only their remuneration but also a sum in excess of that amount reflecting the expenditures elsewhere in the system which result from their professional decisions.

From the foregoing discussion on the accessibility and cost of health services, the position taken in this study is that the mission of auxiliary health personnel is to reach large numbers of previously under-served people with specific kinds of health services. The mission objective is that this should be achieved at low cost to the country.

Since the program's operational objectives are established to enable the program to achieve its mission, the enumeration of program costs generally takes place at the operations level of the program. The enumeration of program benefits (i.e., greater coverage at lower cost) is achieved by calculating the economic value of auxiliary produced outputs. This value may be obtained by multiplying the number of auxiliary produced outputs by the fees chargeable by health professionals for the same service objective. Since the total economic value of auxiliary produced outputs is expected to vary in direct proportion to program coverage, the assumption is that the greater the coverage, the greater the cost savings in professional remuneration, resulting in a lower overall program cost.

Enumeration of the Strategies

The enumeration and summarization of potential strategies and the elimination of those strategies which are clearly not feasible are important steps in a prospective cost-benefit analysis where the economist is concentrating on choosing between two or three proposed strategies or between a proposed strategy and the existing situation (Griffiths, 1988). In a retrospective cost-benefit analysis where the strategy is already operational, the enumeration and summarization of potential strategies and the identification of the most feasible strategy have already been achieved explicitly or implicitly.

What remains is to compare the costs and benefits of achieving the strategy.

The next step is to develop an appropriate model of the strategy. This means defining a formula or graphical representation of how the strategy functions in order to identify the values that will be measured (Kearsley, 1986a). The model thus defines the program inputs, activities, services which is where costs occur, and program impacts and effects where benefits accrue.

Building the Analytical Model

Human Capital Theory

The economist's theory of human capital is an analytical way of viewing investment in learning. According to Parnes (1984) the term capital in economics refers to the stock (e.g., supplies, equipment, machinery, buildings) with which a firm produces goods and services. Human capital, therefore, refers to the stock of men and women employed by a firm and whose capabilities are useful in the productive process (Dillard, 1982; Parnes, 1984).

The knowledge and skills employed by human capital in the productive process are acquired at a cost. Becker (1964) sets out the theoretical arguments concerning how the acquisition of the knowledge and skills used by employees in the productive process is financed. Since the productive capabilities of employees are the property of the individual in the sense that they are attached to him or her, how the acquisition of those capabilities is financed depends in large measure on the ability of the particular capabilities to command a price in the marketplace.

Working with the model of a perfectly competitive firm, Becker distinguished between "general" training and "specific" training. Perfectly general training is the acquisition of productive capabilities that are equally useful in many firms and for which firms are willing to offer competitive salaries. In this respect, teacher education, nursing education, medical education, dental education, etc. are regarded as general training. The property right of the individual in these skills increases the individual's general economic worth and are transferable from one firm to another (Bartel & Borjas, 1977). According to Becker, the financing of such training is the responsibility of the individual.

Specific training as described by Becker is the acquisition of productive capabilities which affect the productivity of the individual for one specific employer. Therefore, these newly acquired skills have limited marketability in the marketplace. In this respect, training programs for Canadian air traffic controllers and Canadian dental therapists are examples of specific training. The knowledge and skills acquired in these training programs are not equally useful to other firms outside the Canadian Government agencies responsible for air traffic operations and dental care in Indian and northern communities. According to Becker, the financing of such training is the responsibility of the employer since such training does not provide the individual with additional employment opportunities in outside firms.

If firms providing specific training are unable to acquire an internal rate of return which will compensate the costs of training, some of the training costs may be passed on to the trainee in the form of lower wages during the training period (Ziderman,

1978). Therefore, it stands to reason that the only sound reason for firms assuming the entire cost of training is the expectation that the internal rate of return will be commensurate with the resources consumed in the training initiative. The idea of results obtained being commensurate with resources consumed, which is the underpinning of the human capital theory, points to a relationship between human capital theory and cost-benefit analysis.

Cost-benefit analysis is a logical extension of the human capital theory. Cost-benefit analysis is a method of investment appraisal. When it is applied to expenditures in the training and subsequent utilization of human resources (the utilization of human resources includes in-service education, supervision, coaching, etc.) it is assumed that these expenditures represent human capital formation (Wood & Campbell, 1970).

Human Resources Accounting

A review of human capital theory was provided in the previous section of this chapter. It was emphasized that the term capital in economics refers to the physical resources of supplies, equipment, and instruments used by firms to produce goods and services. Since the capabilities of humans are used in the productive process, human capital refers to the resources of men and women employed by firms to assist in the productive process. Like physical capital, human capital has costs or expenses, but should also generate positive economic returns to the firm. Carnevale and Schulz (1990), and Garbutt (1964) a quarter of a century earlier, noted that it may be that training is the only way in which a firm can acquire the pool of labour with which to

operate. Furthermore, the workforce will require continual skills upgrading to maintain and/or increase the economic returns to the firm. Therefore, like physical capital, the operational costs of acquiring human capital and keeping it in "good operating condition" must be identified and recorded. This emphasis on economic evaluation of human capital and related periodic returns on investment in human capital is the cornerstone of human resources accounting (Carnevale & Schulz, 1990; Dillard, 1982).

Human resources accounting is extremely important to heath systems agencies. Government agencies are beginning to question the rising cost of health care, most of which represents the cost of human resources. The provision of health services has always been a labour-intensive effort (Dillard, 1982; Hall & Mejia, 1978; Ray, 1983; Schaefer & Pizurki, 1984). Mejia (1980), in an article on world trends in health manpower development, stated that "given the labour-intensive nature of the health industry, manpower consumes between 60%-80% of the health budget of many countries" (p.113). With human resources alone accounting for so much of the health budget, it is easy to understand why it is necessary to establish an outlay cost system to identify costs of selection, recruiting, hiring, training, and deploying staff for defined work in the organization. From this concept of financial accounting of human resources, it is but a short intellectual hop to the idea of cost-benefit analysis of the training and utilization of auxiliary health personnel.

Human resources accounting is an information system that focuses on identifying and measuring the operational costs and benefits of a firm's human resources (Dillard,

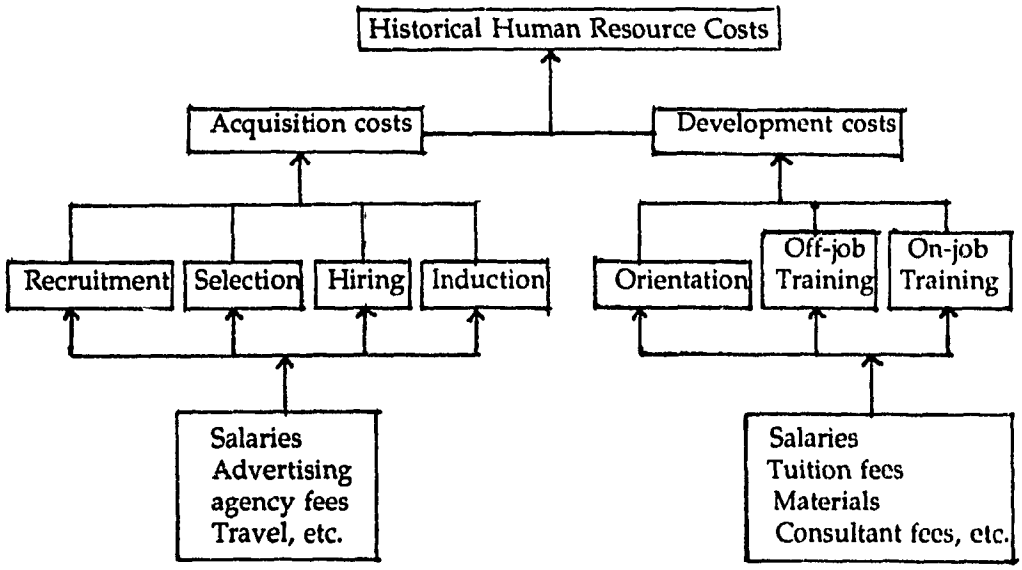
1982). Eric Flamholtz (1978), considered the dean of human resources accounting, describes these operational costs as costs incurred by a firm to recruit, select, hire, train, and develop the human resources used in the productive process.

Flamholtz developed a model (see Fig. 9) for the measurement of costs incurred to acquire and to develop human resources. This model, referred to as the Historical Cost Model (Flamholtz, 1978), depicts two elements of cost out lay: acquisition costs and development costs. Each of these two elements are broken out into their respective cost components. Acquisition costs include costs incurred in recruitment, selection, hiring, and inducting human resources. Development costs are referred to by Flamholtz as the sacrifice that must be incurred by firms to train an individual to the desired level of performance expected in a given position. Development costs include costs associated with orientation, on-the-job training, and off-the-job training. The underlying assumption of this model is that the full costs of human resources can be identified and measured.

The limitation in the Historical Cost Model is that it does not embody the economic returns to the firm for investments in human resources (Carnevale & Schulz (1990). Nonetheless, it does provide the conceptual framework for examining the costs of training and utilizing auxiliary health workers.

There is no single model for a training program for auxiliary health workers. There are a variety of possible ways in which the training and utilization of auxiliary health workers may be operationalized. Over the past two decades there has been a proliferation of literature on the subject. Most writers in the literature indicate that

Figure 9
Model for Measurement of Historical Human Resource Costs



Source: Flamholtz, Eric G. (1978). Human Resources Accounting. In S. Davidson and R. Weil (Eds.), Handbook of Cost Accounting. New York: McGraw-Hill

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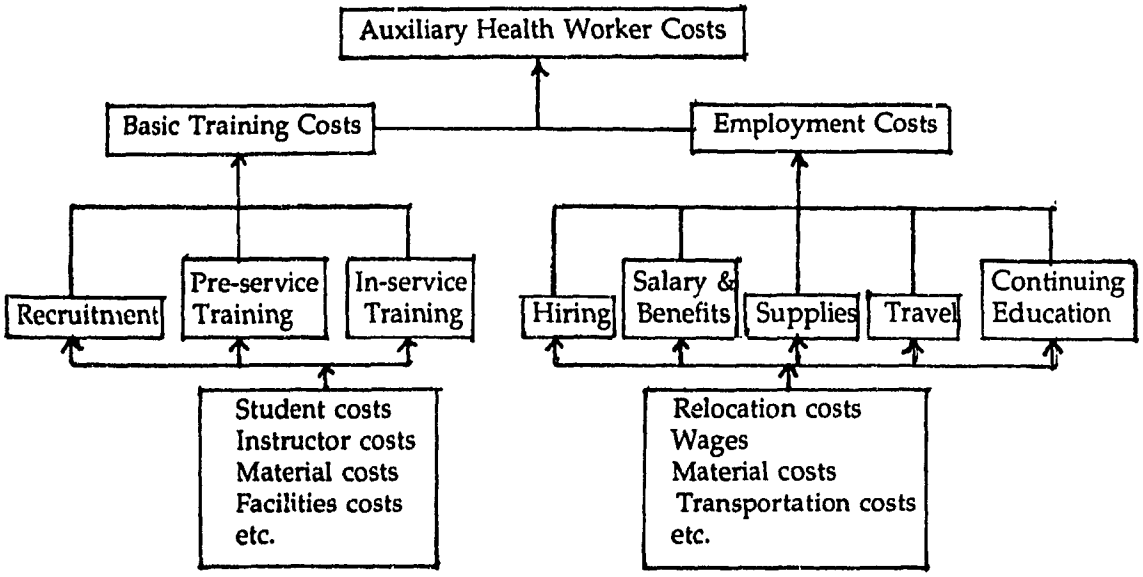
there is a period of formalized, pre-service training after which the auxiliary moves into the formal health system (Abel, 1981; Gerber, 1981; Heller, 1981; Storms,1979; WHO, 1979). If it can be theorized that the costs of training and utilizing (employing) auxiliary health workers occur in that order, a model, similar to that of Flamholtz's, can be constructed to provide an operational framework for the identification and classification of relevant costs.

Figure 10 on the following page represents a model for the measurement of the two basic elements in human (auxiliary health worker) resources cost: basic training costs and employment (utilization) costs. The model depicts many of the critical

Figure 10
Model for Measurement of Auxiliary Health Worker Costs



dimensions that determine the cost of training and utilization. Basic training costs refer to the cost incurred to train the individual to the level of performance set forth in the scope of practice or job description. The scope of practice establishes the parameters of activity with corresponding levels of competency required of the fully-qualified auxiliary health worker. In competency-based training programs, the scope of practice is the instructional goals as described by Dick and Carey (1985) and Gagne, Briggs, and Wagner (1988) since it is a statement of the desirable state of affairs.

Recruitment costs are considered here as a component of basic training costs on the conjecture that, in addition to possessing important personal/social attributes needed to do the job, there is the important underlying requirement that the successful

candidate be available for and capable of undertaking the prescribed instruction; it is also assumed that only individuals who successfully complete basic training will enter into the health care delivery system as a provider. From a practical or budgetary point of view, it is recognized that in some quarters recruitment costs may be considered an employment cost.

Recruitment costs are costs incurred in attracting, identifying, and selecting candidates for training. These costs include advertising costs, postage, telephone, and associated travel.

Pre-service training costs are those costs incurred in the initial formal training period prior to entering service. It includes formal classroom training, field training, field placement, or supervised practicum which may be a prerequisite to assuming any official responsibility at a service delivery point.

In-service training costs are costs incurred during the on-the-job training period which, in some training schemes, is part of the basic training and follows formal pre-service training. In many parts of the world this approach to training is as much a sociocultural necessity as a strategy for organizing learning experiences. As acknowledged by Wood,

> Requiring trainees to be away from their homes for long periods may exclude married women, offend customs regarding the unmarried and prevent all from continuing their normal participation in local activities. In particular if people are away from their homes during the planting season they will have no food when they return (Wood, 1981, p.4).

Heller further notes that,

> One must presume that the type of person likely to be a [primary health care worker], particularly in rural areas, is someone with limited education. One must also assume that there are limits to the amount of information that can be taught to such a person, retained and effectively applied in the field ... This suggests that the requirements for [basic training] not end after an initial 10 or 20-week course, but that there will be a need for [on-the-job] training ... (Heller, 1981, p.101).

Many basic training programs are provided in modular form with periods of classroom training followed by periods of on-the-job training. Abel (1981) described the length and scheduling of training of primary health workers in India,

> Following the first week of formal training was one month of supervised in-service training ... this was followed by a second week of formal training (p. 18).

Costs incurred during pre-service and in-service training are similar. The challenge is to collect information on the costs of all factors that enter into pre-service training and on all factors that enter into in-service training. The imputed costs would consist of student costs (e.g., salary, training allowances, per diem, travel, etc.), instructor costs (e.g., salary, per diem, travel, etc.), materials cost (e.g., training aids and devices, books, supplies, etc.), and facilities cost (e.g., rent, utilities, maintenance, etc.). Basic training costs are allocated to the number of people actually completing training.

Employment costs refer to the sacrifices which must be incurred to bring a trained auxiliary health worker to a position and to maintain him or her as a part of the productive process. Employment costs are composed of five elements (1) hiring; (2) salary and benefits; (3) supplies; (4) travel; and (5) continuing education.

Hiring are costs incurred to bring the individual into the firm and place him or her in the job. Hiring costs include costs of moving and travel allowances and other related costs such as administrative costs incurred to place an individual in a job.

Salary and benefits are cash expenditures expressed as wages, isolation post allowances, and the cash value of the employer's contribution to employee's supplementary benefits (e.g., health plans, unemployment insurance).

Supply costs refer to costs incurred for the purchase of supplies and materials for varying levels of service provided. McBride et al. (1987) discussed the effects of varying levels of service on cost. According to these authors, varying levels of productivity in health care delivery will result in varying levels of program operating costs. The dynamic nature of auxiliary health worker programs will result in monthly variations in service levels leading to variations in monthly program costs. In this model supply costs are the variable costs of expendable instruments, surgical supplies, medication, and teaching aids.

Travel costs are costs incurred to bring the auxiliary health worker to other sites or locations for the exercise of his/her duties and responsibilities. The major components of travel costs are transportation costs, meals, and accommodations.

Continuing education is here interchangeable with staff development and refers to that part of learning that is addressed after basic training is completed and includes job orientation (Boissoneau, 1980). Typical continuing education costs include salary of trainers, tuition, fees, transportation costs, meals, accommodations, and materials.

A review of cost-benefit analysis as an input/output model was provided in a previous section (see Fig. 7). The model developed and described in this section addresses the input variable (costs) of the cost-benefit analysis of the training and utilization of auxiliary health workers. The next section will develop a model which will bridge the input variables (costs) with the output variables (benefits) and describe the output variables.

Organizational Elements Model

A useful frame of reference which relates inputs to outputs is Kaufman's (1988) Organizational Elements Model (OEM). The OEM is a model for analyzing organizational performance in terms of what resources are employed and how they are employed, what they accomplish, and the impact of all of these on a beneficiary group such as an individual, society, or a firm (Kaufman & Stone; 1983). On defining the model, Kaufman and Thiagarajan (1987) state that

> The OEM places into relationship and perspective people, resources, and results and allows one to identify and solve performance problems correctly and quickly (p. 115).

The model consists of five organizational elements, two of which are related to the *organizational effort* (what is used and how it is used), two of which are related to the *organizational results* (what it accomplishes), and one of which is related to the outcomes of organizational efforts and organizational results, which are the *benefits* or the quantifiable impacts and effects. The five elements in the model are, Inputs, Processes, Products, Outputs, and Outcomes and are defined in Figure 11.

Figure 11
Organizational Elements and Examples

Organizational Elements	**INPUTS** (Ingredients, raw materials)	**PROCESSES** (How-to-do-it; ways and means; activities)	**PRODUCTS** (En route results)	**OUTPUTS** (Results deliverable to society)	**OUTCOMES** (Im act & effects)
Examples	Staff Supplies Equipment Facilities	Methods Means Procedures Techniques	Courses completed Services delivered	Graduates Patients seen Increased coverage	Profits Lower Co Improved quality of life
Cluster	Organizational Effort		Organizational Results		Benefits

Source: Adapted from: Kaufman, 1988, p. 30; and Kaufman & Stone, 1983, p. 70.

Organizational Effort

Organizational efforts are the *inputs* which are the ingredients to planning and doing, and the *processes* (activities) which are the ways and means) of managing and employing inputs to achieve a result (products, outputs, and/or outcomes).

Inputs refer to all of the human and physical resources, policies, rules and regulations used by the organization to achieve its mission. Wages and benefits of human resources and the cost of acquiring and using physical resources are obvious inputs into the organizational effort.

Processes are the "doing" of things. It is the way in which organizations use resources and inputs. According to Kaufman and Thiagarajan (1987), the processes in OEM are characterized by words ending in "ing": teaching, learning, managing, treating, testing, providing, evaluating, etc.

Organizational Results

Resources (inputs) managed and employed in a specific way will lead to results. Results are expressed in terms of *products* and *outputs*. The distinction between products and outputs is essentially one of parts and whole. Products are basic first-level results which are useful when combined with other products to produce outputs. Thus, outputs are an aggregation of products. The products of training would be tests passed, courses completed, internship completed which lead to an output: graduated, qualified worker. The products of service delivery would be different kinds of treatment and preventive services which lead to an output of decrease in incidence and prevalence of illness and improvement in health status of clients.

Benefits

Organizational effort and organizational results, if done right, will culminate into outcomes which are beneficial to the individual, to society, or to the organization. *Benefits* are the valuable outcomes, the quantifiable impacts and effects, which allow the beneficiary to survive, prosper, or expand (Kaufman & Stone, 1983). The benefits of training which accrue to the individual would be the ability to acquire and/or keep a job, self-sufficiency, more disposable income, a higher standard of living. Benefits of training which accrue to society are related to the benefits which accrue to the individual and include fewer people on welfare and increase in tax revenues. The benefit of training which accrues to the firm is a competent pool of labour leading to increase in productivity and/or decrease in costs, including decrease in staff turnover.

The benefit to society of service delivery by a trained, competent auxiliary health worker is increased accessibility and utilization of health services, decrease in incidence and prevalence of morbidity, and, hopefully, mortality. The benefit to health systems agencies for utilizing trained, competent auxiliary health workers is increased coverage at lower cost.

Application of Organizational Elements Model to Training and Utilization of Auxiliary Health Personnel

Kaufman's Organizational Elements Model provides a conceptual framework for understanding the relationship between inputs and outputs in a cause-and-effect way. That which a health systems agency uses (inputs) are applied to doing things (processes) which have results (products, outputs and outcomes). The model is neither

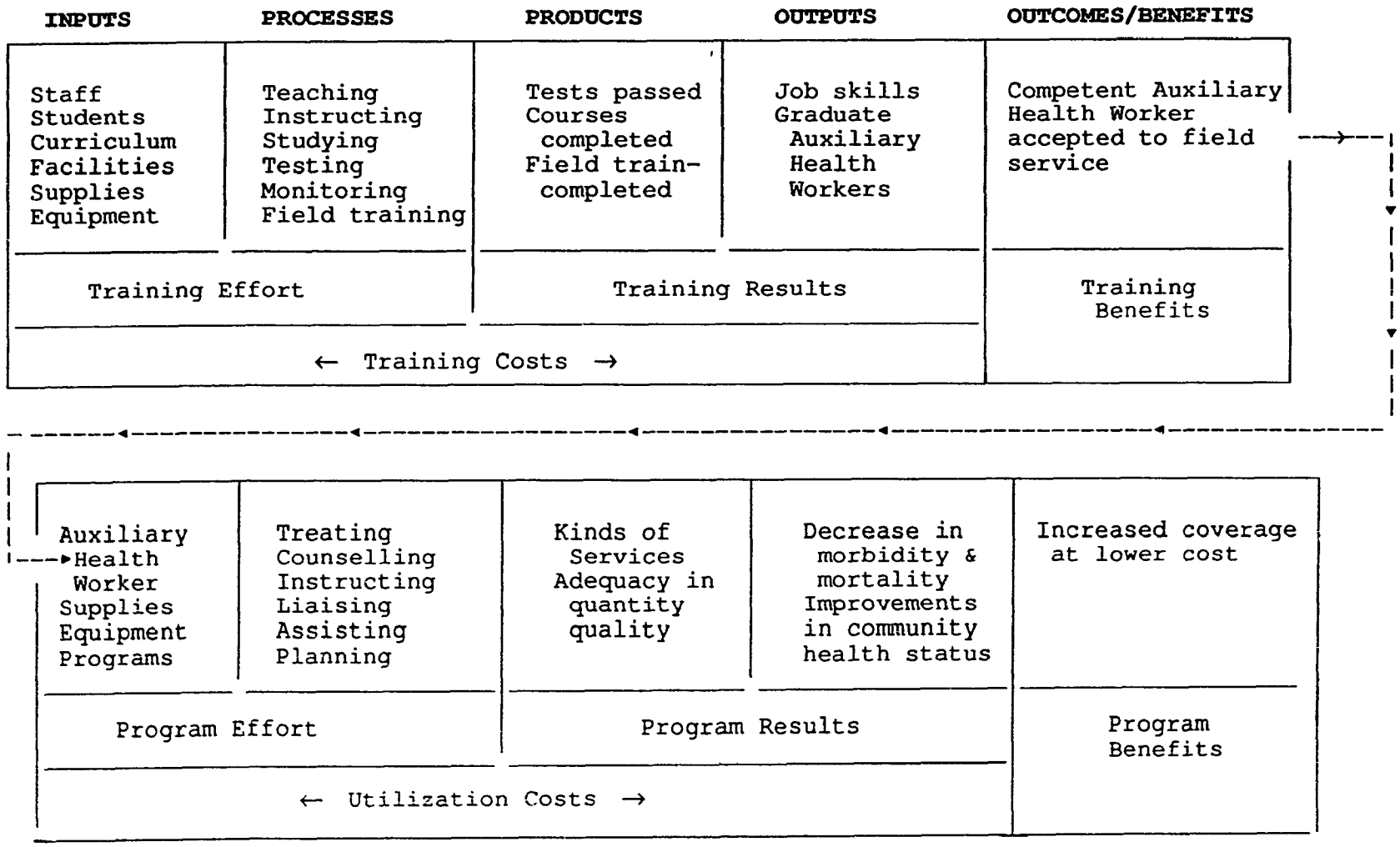
linear or static (Kaufman & Stone, 1983). Accomplishments within one of the organizational elements may lead to another accomplishment within the same element before it leads to accomplishments in the next higher level. Reading each chapter of a unit, studying the unit, taking a unit exam, passing the exam, and proceeding to the first chapter in the next unit are sequential accomplishments within the process element.

The Organizational Elements Model is a dynamic model where the results of one process are used as an input into another process which builds still another result. Figure 12 on the following page proposes the dynamic flow of organizational elements in the training and utilization of auxiliary health workers in which the outputs of training are used as an input in the utilization scheme. The effort/results paradigm also provides a useful way of visualizing the costs of a result (product, outputs) along with the benefits to be accrued from the successful achievement of the results in a cause-and-effect relationship.

The model depicted in Figure 12 is an over simplification of the real system in order to provide a holistic or macro perspective of cost-benefit analysis wherein the cost of the efforts and results and the benefits to be gleaned take priority over understanding the dynamics of what is going on within elements and between organizational elements.

There are three critical elements in the model for determining the costs of training and costs of utilization. These are: **field training**, **kinds of services** provided by the auxiliary, and the **adequacy of services** in terms of quantity and quality. Each of

Figure 12
The Flow of Organizational Elements in the Training and Utilization of Auxiliary Health Workers: The Health Agency Perspective



these elements will have consequential effects on both cost and benefits.

Field Training

Some training programs for auxiliary health personnel are almost entirely on-the-job or service-based. In this way students are put in contact with real life situations and in a systematic way acquire the knowledge and skills for solving them. Some training programs include some type of supervised field practicum or clinical experience near the end of the program in an institution or a community. This allows students an opportunity to apply skills learned in the classroom in an actual health care delivery setting.

Practical work situations will initially constitute a cost to the health systems agency. As students advance through the program, honing their skills and requiring less individualized supervision, they begin to provide a benefit to the agency. The cash value of labour produced by students should be used to off-set the total cost of training since this labour will usually result in revenue generation or cost avoidance to the agency.

Kinds of Services

The definition of the functions and activities of auxiliary health personnel proceed from a study of the health needs and demands of the population and the health service targets specified by the agency. Health needs, health demands, and service targets are converted into manpower requirements, taking into consideration the number, kind, levels of qualification, and ultimately the functions and activities they will be expected

to carry out (Hall, 1978). These variables will have a very significant effect on the cost of training and cost of employment and the scope and value of the ensuing benefits.

The definition of the specific tasks and procedures to be taught to prospective auxiliary health personnel flows from the functions and activities to be assigned to them. The functions and activities are analogous to instructional goals as defined by Dick and Carey (1985). It is evident that the health needs and demands of the population give direction and shape to which tasks and procedures will be assigned and taught (Allred & Hobdell, 1986; Barmes, 1969; Berman et al, 1986; Guilbert, 1981).

Berki (1973) claims there are two basic dimensions along which new types of health manpower are ranged: skill specificity and sequential position. According to Berki,

> Skill specificity is defined in terms of patient types, body functions, procedures, anatomical parts, or some combination of them. Skills may range from narrow to broad. The sequential position of new types of health manpower refers to its position in the diagnostic-therapeutic process vis-à-vis the [professional health worker (e.g., physicians, dentists)] (Berki, 1973, p 106).

Following Berki's two dimensions, the skills of certain categories of auxiliary health personnel may be limited to a specified number of defined tasks and procedures and may be further limited to anatomical parts, as is the case of dental assistants. The dental assistant works in close tandem with the dentist such that his/her sequential position is clear. The skills of other types of dental auxiliaries, such as the Canadian

dental therapist, may be more broadly defined in terms of procedures but narrowly in terms of patients. The sequential position of the dental therapist is variable since the dental therapist will perform some functions at an early stage prior to the patient's contact with the dentist, while other functions will be performed based on treatment plans established by the dentist. The variable sequential position of the dental therapist adds another dimension to the complexity and adequacy of the tasks to be performed. It is clear that the degree of specificity embodied in the auxiliary health worker and its sequential position are essential factors in their training, in the dental care continuum, and the resulting output (Berki, 1973).

Based on the preceding discussion, one can conclude that the costs and consequences of the training and utilization of auxiliary health personnel will depend strongly on what kinds of skills are introduced via the auxiliary health worker and at what stage in the health care process. The greater the number and complexity of the identified tasks and procedures, the greater the impact will be on training costs in terms of number and types of teaching staff, facilities and equipment, and the time allocation for training. The kinds of interventions which will be selected, taught and assigned to dental therapists will determine the kinds, hence cost, of supplies and equipment. Finally, auxiliary health worker remuneration must be appropriate to task complexity as well as degree of responsibility and conditions of work.

Adequacy of Services

Adequacy of services is expressed in terms of quantity and quality of services provided. A critical dynamic factor shaping the quantity and quality of services is the

scope of services and biological efficacy of the interventions provided by the auxiliary health worker. The scope of services provided by the auxiliary health worker may be limited, but provided to a large population base. On the other hand, the scope of practice may be wide and varied, but provided to a small population base.

Traditional theories of demand inform us that a basic premise for the proper use and successful functioning of auxiliary health personnel is optimal client satisfaction (Berki, 1973; Heller, 1981). There is a causal link between efficacious interventions, client satisfaction, and future service utilization by clients (Berki, 1973; Torbert, 1990). This will affect the quantity of services provided (output) which will figure significantly into the quantification of benefits accruing to the health systems agency. Therefore, coverage - or reaching a significant proportion of a specified population with specified services - is a prime factor in the quantity of services provided.

To quantify the services of auxiliary health personnel is analytically rewarding and empirically uncomplicated, but its interpretation is limited without some consideration of the quality dimension. Quality, like beauty, is in the eye of the beholder. Clients may have unrealistic expectations of what the service outcomes should be. Technically, quality of care refers to interventions which are performed in conformity with recognized technical standards (Berman, 1984).

It has been pointed out that client satisfaction is an important factor in the quantity of services provided. Low levels of client satisfaction are equated with low levels of demand and utilization. Some aspects of client satisfaction relates directly to quality of care. Although this factor is not a necessary or sufficient measure of the outcomes

of care (Brooks & Lohr, 1985), if not at an acceptable level, it can have a downward compression on benefits accruing from the program.

The relationship between costs and quality is not fully understood (Brooks & Lohr, 1985). At a very basic level the effects of quality of care on costs may be demonstrated where interventions do not conform to recognized technical standards and must be repeated either by the auxiliary health worker or by the supervisor. Services which are provided repetitively and inappropriately are costly in terms of wasted manpower and added materials (Abramowitz & Mecklenburg, 1972).

In general, the quantity of services provided will result in productivity gains while the quality of services will result in cost reductions. Thus the kinds of services provided by auxiliary health personnel and the adequacy of those services in terms of quantity and quality, will increase the gains flowing from their employment.

Specifications of the Research Model

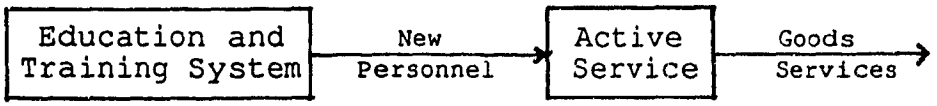
In the two preceding sections of this chapter two models were proposed: a model representing the measurement of costs of training and employing auxiliary health personnel (Fig. 10), and a model illustrating the link and causal relationship between auxiliary health workers' outputs and program costs and benefits (Fig. 12). The final step is to integrate the components of the two models into one model depicting the costs and benefits of training and employing auxiliary health personnel.

Earlier in this chapter it was stated that cost-benefit analysis is a mathematical model used to illustrate relationships in an equation. Chorny (1973) identified four

steps for constructing a mathematical model: (a) identify the problem to be solved and the characteristics of the system, (b) determine the output of the model, (c) identify the variables which influence the output, and (d) identify the system's causal mechanism. Once these four steps are achieved, the model is ready to be tested.

Following the steps of Chorny's prescription, the first requirement in building the model is that the system be well identified and the objectives for which it is being analyzed be well established. The system under study is the training and utilization of auxiliary health personnel. The objective of the system is to increase health care coverage in underserved areas at low cost. The problem is to determine if the goods and services produced by auxiliary health personnel justify the costs of training and employing them. An analysis of the problem is necessary to determine the key components of the system and the variables which influence them. In the system under review (the training and utilization of auxiliary health personnel - from the perspective of the health systems agency), two subsystems, training and utilization, are apparent. This system is visualized in the following model:

Figure 13
Simplified System for Training and Utilization of Auxiliary Health Personnel



Let us assume that the objective of the system is clearly defined, that the problem is well stated, and that there is a definite system.

The second step is to determine the output of the system which must be known in relation to the stated objective of the system. The output of the system is a specified level of service for the least cost. The output is, of course, much more complex simply because the subject of analysis is complex. The question might arise if the kinds and quantity of services provided by auxiliary health personnel is not the output of the system. Kaufman (1988) would argue that the kinds and quantity of services are en-route outputs, the aggregation of which leads to the specified level of service. In this case the correspondence between the system's en-route outputs and the system's outcome is one of parts and whole, that without the en-route outputs the objective of the system cannot be achieved. The output of the system is depicted as follows:

Figure 14
Modified System for Training and Utilization of Auxiliary Health Personnel

Once the output variable has been established, the third step is to determine all the variables which influence it. Better coverage at low cost is here defined as increased

availability of services at costs lower than the relative cost of the more expensive provider (i.e., the professional practitioner). The variables influencing this output are:

- the kinds and quantity of services provided.
- the dollar value of these services.

These will be offset by:

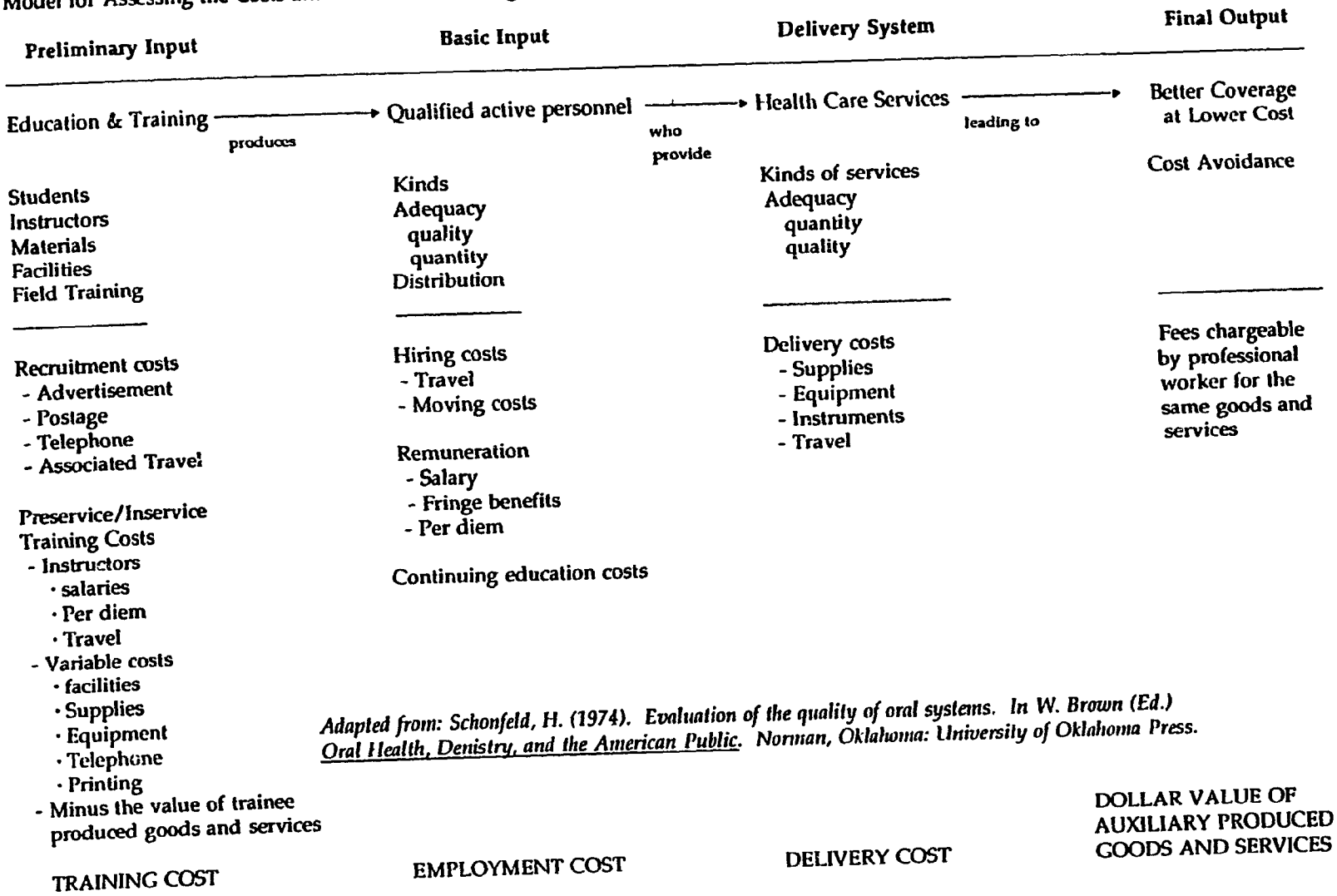
- the cost of training the auxiliary health worker
- the cost of employing the auxiliary health worker.

Each of these variables is a function of the others. The cost of employment is a function of the number of auxiliaries trained. The cost of training is a function of the kinds of services the auxiliary will be expected to deliver. Using these primary variables and selecting the necessary attributes from Figure 10 and Figure 12, it is now possible to develop the model. (See Fig. 15)

The model presented in Figure 15 is first of all a systems approach depicting the components of the system, the interrelationships among the components and the way the structure lends itself to achieving its objective. Cost-benefit analysis is said to demonstrate cause-and-effect relationship in an input/output model (Anthony & Young, 1984a). The model makes clear the implicit causal relationship between inputs and outputs.

The model in Figure 15 borrows from the conceptual framework of Kaufman's Organizational Elements Model which provides a holistic way of selecting and linking the various units for analysis. The most conspicuous difference is that "delivery system" in the present model encompasses "processes", "outputs", and "products" in

Figure 15
Model for Assessing the Costs and Benefits of Training and Utilizing Auxiliary Health Personnel



Adapted from: Schonfeld, H. (1974). Evaluation of the quality of oral systems. In W. Brown (Ed.) Oral Health, Denistry, and the American Public. Norman, Oklahoma: University of Oklahoma Press.

Kaufman's Organizational Elements Model. Identifying or breaking out these elements separately in Figure 15 would not increase the conceptual clarity.

The model depicted in Figure 15 also includes the cost items from the Model for Measuring Auxiliary Health Personnel Costs (Fig. 10). In the present model cost items are organized in order of occurrence which is why the costs of delivery system's supplies and equipment are not identified under the input elements.

The fourth and final step in Chorny's prescription for constructing a mathematical model is to identify the system's causal mechanism. This would make it possible to calculate the output by means of well-defined succession of steps which is characteristic of an equation. Each step represents a variable which can be quantified and calculated on the basis of its value.

From a purely economic point of view, an investment in a program is deemed justifiable if the sum of the benefits minus the sum of the costs is a positive value. The result, which tells us the absolute gain due to the program, is called the Net Present Value (NPV) of the program and is illustrated in the following equation:

$$\mathbf{NPV = Benefits - Cost}$$

The problem being addressed in this study is, from the perspective of the health systems agency, whether the value of the goods and services produced by auxiliary health personnel justify the cost of training and employing them. The decision rule is that the Net Present Value must be greater than Zero. The equation is stated as follows:

$$\mathbf{Benefits - Cost = NPV > 0}$$

Applying the variables in the present model to the above equation, the following mathematical model is produced:

Dollar value of auxiliary produced goods and services	-	Training Cost	-	Employment Cost	-	Delivery Cost	= NPV > 0

Kaufman and Stone (1983) have appropriately made the following observation concerning models:

> All models are just that - representations of reality. None is perfect, and none always completely represent the current or future world (p. 52).

The model depicted in Figure 15 is likewise imperfect. One problem in using the model is a problem common to all cost-benefit analyses: the lack of rules on what is a justifiable cost or effect (Austin, 1978; Bloom, 1986; Creese, 1986). Ultimately the researcher is placed in the position of making assumptions about such items as salaries, fringe benefits, training costs, etc. Like any other assumption, they must be supportable.

The present model is an over-simplification of a training and employment scheme for auxiliary health personnel, which means there are boundary problems. The exact placement of this model on some training and utilization schemes would require adjustments.

Intangible Benefits

In cost-benefit analysis a dollar value is placed on benefits so that they can be directly compared with costs. An accusation levelled against this type of economic evaluation is that it neglects the intangible benefits because they are not quantifiable.

Examples of intangible benefits of training and utilizing auxiliary health personnel are such factors as involvement of members of the target population in the planning and delivery of health services, political gain in providing health services to underserved people, and the advancement of social goals such as distributional equity.

The problem of intangible benefits has been addressed by many researchers and has not been completely resolved (Drummond & Stoddart, 1985; Klarman, 1974). Anthony and Young (1984b) pointed out that since not everything can be quantified, it would be fallacious to expect cost-benefit analysis to do so. They further caution that an analysis that claims to have quantified everything is highly suspect and of doubtful merit.

Cost-benefit analysis remains a useful tool in the presence of intangible benefits. In such circumstances the researcher is expected to identify as many of the relevant tangible and intangible benefits as possible, quantify and value the tangible benefits, and describe the intangible benefits (Drummond & Stoddart, 1985; Joglekar, 1986; Treasury Board, 1982). If decision-makers are presented with both sets of indicators, they will have the best possible information on which to base their decision.

Summary

This chapter presented the conceptual and methodological framework for the analysis in this study. A cost- benefit analysis, from the perspective of the health systems agency, of training and utilizing auxiliary health personnel is based on the human capital approach which views training as an investment in people which

enables them to be more productive and increase the material well-being of the agency taking responsibility for their training and employment. It is also based on the principles of human resources accounting which views human capital as an expense incurring costs related to recruitment, hiring, wages, benefits, etc.

Cost-benefit analysis implicitly assumes there is a causal connection between the cost of a program and the benefits derived. This implies that there is an underlying input/output model that describes both essential variables. The use of models in problem-solving and decision-making is what distinguishes operations research from other branches of research.

Operations research advocates the systems approach to model building. Kaufman's Organizational Elements Model is one way of organizing and visualizing the inputs and outputs of a system. The logic in Kaufman's model provides the analytical framework for the specification of the model used to analyze the costs and benefits of training and utilizing auxiliary health personnel.

CHAPTER V

METHODS AND PROCEDURES

This study was conducted to gain insight into the costs and benefits of training and employing dental therapists to provide a limited range of dental services including, but not limited to, preventive services, in Indian and northern communities of Canada. The study was conducted from the perspective of the health agency, Health and Welfare Canada, responsible for their training and deployment. Knowledge of the costs and benefits of training and employing dental therapists will be of interest to health planners, health economists, professional dental organizations, employers of dental therapists, and to individual dental therapists. Data from the study will provide decision-makers with the information needed to determine the amount of effort needed to ensure Health and Welfare Canada will get the best value for its dollar and ultimately to assess priorities for resources to be allocated to the program. The data from the study will also provide information needed for considering the professional recognition of dental therapists by dentists and dental associations.

Research Design

The study was conducted in three separate but interrelated phases. Phase one of the investigation focused on evaluating the efficiency of the dental therapy program in obtaining results commensurate to the resources consumed. Phase two of the investigation assessed the quality of care provided by dental therapists. This phase of the

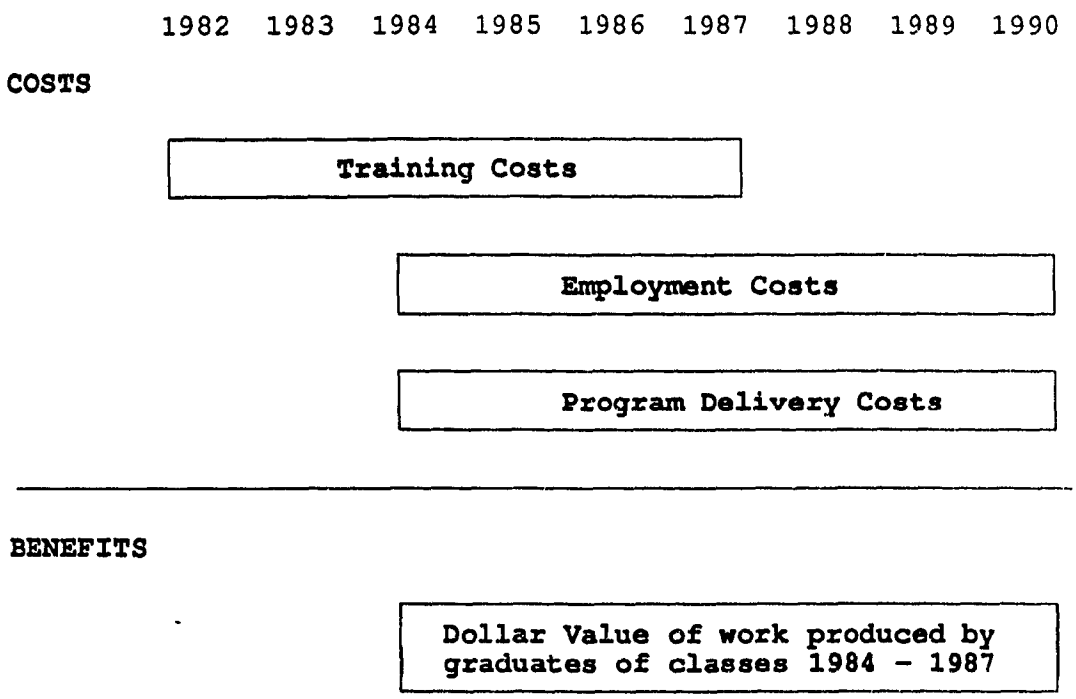
study provided an additional line of evidence of the results obtained from the dental therapy program. The third and final stage of the study investigated dental therapists' predisposition and sentiments toward their job experiences. The extent to which dental therapists' job experience contributes to their aspirations and self-fulfilment will have a measured effect on the ability of Health and Welfare Canada to recoup the costs of training and employing them.

Phase One - The Economic Analysis

The economic analysis was conducted using an *ex post facto* intracohort trend study of 32 dental therapists who graduated between 1984 and 1987 and who were subsequently employed by Health and Welfare Canada. An intracohort trend study is described by Glenn (1977) as the comparison of the characteristics of one cohort at more than one point in time. In the economic analysis the characteristics being compared were the costs and benefits directly associated with the training and subsequent employment by Health and Welfare Canada of the members of the cohort. These were measured annually from the beginning of training through graduation and employment to termination or to June 30, 1990, whichever came first.

Figure 16 depicts the design and time lines associated with the economic analysis. Since the training program for dental therapists is carried out over a two-year period, training costs were calculated from 1982 when the graduates of 1984 matriculated. Explicit in the diagram is the concept that costs and benefits do not have to occur over the same time horizon provided the enumerated costs are causally linked to the enu-

Figure 16
Relationship Diagram of the Time Lines Associated with the Cost-Benefit Analysis of the Training and Utilization of Dental Therapists



merated benefits.

Data for phase one came from financial and personnel records, dental therapists' monthly work summaries, and annual dental fee guides from the provinces and territories where dental therapists are employed.

Phase Two - Quality of Care

This phase of the investigation was conducted in two parts. The first was a statistical analysis of data generated by an earlier study. The second part was a

statistical analysis of data drawn from the Annual Work Summaries of all dental therapists between 1978 and 1988. The second part is described in more detail under "Statistical Analysis" below.

On January 8, 1989, Medical Services Branch of Health and Welfare Canada, contracted with Dr. Ralph Crawford and Dr. Bradley Holmes, two independent dentists, to assess and evaluate the dental treatment provided to the Inuit people living on Baffin Island. The delivery systems in use on Baffin Island at the time of the study were (a) private practitioner contract, (b) McGill University contract, (c) dental locum, and (d) dental therapists. The unpublished report submitted to Medical Services Branch is titled An Assessment and Evaluation of Dental Treatment in the Baffin Region (Crawford & Holmes, 1989) and is dated January 25, 1989.

A straight random sample of restorations completed by dental therapists and dentists was examined for each of five study locations. Patients examined in the study had received treatment within the previous eighteen months. Examinations were made with the aid of mirrors, explorers, and dental light. The examiners did not know which of the sample of restorations had been completed by dentists or by dental therapists.

For this study the evaluators used a rating guide developed by Ryge and Snyder (1973) (Appendix J) for post-treatment evaluation of clinical services. This guide was designed to standardize post-treatment assessments as well as for rating the quality of restorations. The study rated dental restorations as "superior", "satisfactory", or "failed" against the criteria set forth in the Ryge and Snyder rating guide.

The statistical analysis of the data was under-represented in the report submitted by the researchers. The data submitted were in the form of frequency distributions and proportions for each classification of restorations, and did not include statistical comparisons between providers for each type of restoration. Also, the report did not specify the number of dental therapists and dentists represented in the study. Since the report did identify the communities where the assessments were made and the treatment time-period, the present researcher was able to determine from available records that the number of dental therapists represented in the study is eight. Determining the number of dentists involved was more problematic and the information was never complete. The number of dentists involved in the study was at least as many as the number of dental therapists.

Phase Three - Predisposition and Sentiments of Dental Therapists Concerning Job Experiences

This phase of the research was structured around data drawn from a descriptive employee attitude survey conducted in May - June 1990. Various researchers (Cohen & Manion, 1980; Isaac and Michael, 1981; Kerlinger, 1987) rate the descriptive survey as the most widely used technique in educational and personnel research. Since the entire population of dental therapists employed in Indian and northern communities of Canada was surveyed, population sampling was not applied.

Methods

The data for this study came from five different sources: (1) a survey of all

practicing dental therapists, (2) the monthly work summaries of dental therapists, (3) personnel and financial records of the National School of Dental Therapy, Health and Welfare Canada and the Government of the Northwest Territories, (4) provincial and territorial dental fee guides and (5) an earlier study by Crawford and Holmes (1989) assessing dental treatment in Baffin Region of the Northwest Territories. For the purpose of clarity, data sources and instrumentation for each of the three phases of the study are set forth in the Table 8.

Table 8
Data Sources for the Three Study Phases

	Group One			Group Two	Group Three	Group Four
	F/P[1]	W/S[2]	F/G[3]	Crawford & Holmes Study of Dental Rx in Baffin Region	Annual Work Summaries 1978-1988	The Surveyed Population
Phase						
1	X	X	X			
2				X	X	X
3						X

[1] - Financial and Personnel Records
[2] - Dental Therapists' Monthly Work Summaries
[3] - Provincial Dental Fee Guides

Subjects

The subjects in the study consisted of four groups of dental therapists. The first group in the study was composed of 32 subjects who graduated from the National School of Dental Therapy between 1984 and 1987. The subjects were followed-up from date of graduation and employment until date of termination or June 30, 1990,

whichever came first. Two dental therapists of the 32 are presented in Group Two (N=8), all are represented in Group Three, and 26 are presented in Group Four, the remainder having terminated prior to the field survey. Unobtrusive measures were employed to collect data on this group. Training and employment costs were gleaned from personnel and financial records. Dental Therapists Monthly Work Summaries provided necessary data for the quantification of the kinds of services provided. The provincial dental fee guides were used to assign a market value to the services in money terms.

Group Two is the dental therapists involved in the Crawford and Holmes (1989) study of dental treatment in Baffin Region, Northwest Territories. The study did not report the number of dental therapists involved in the study. The study did provide information on study sites and time-period. With this information the present researcher was able to determine that eight dental therapists are represented in the study. Of that number all are represented in Group Three and five were present in Group Four, the remaining having terminated before the survey.

Group Three consisted of all dental therapists employed between 1978 and 1988. Data pertaining to dental restorations, dental extractions, and preventive d ıtal work were obtained from their Annual Work Summaries between 1978 and 1988. These data were supplementary to data obtained from Group Two and were used to provide additional information on quality of care.

The fourth group in the study was the surveyed population (N=66) which consisted of all active dental therapists currently employed in Indian and northern

communities. This group consists of male and female, native and non-native therapists working in urban, rural and isolated communities in both territories (Yukon Territory and the Northwest Territories) and in seven of the ten provinces.

Description of Instruments and Collection Procedures

Questionnaire

Each dental therapist in Group Four of this study received a survey questionnaire. There were essentially five parts in the questionnaire (Appendix B). The first part (questions 1-8) requested demographic data including age, sex, ethnicity, geographical location of the job, education level, and years of experience. The second part (questions 9-10) consisted of questions related to quality of care and solicited information pertaining to continuing education experiences and the availability of supplies and equipment. The third part (questions 11-12) contained two almost identical lists of attitudinal factors used to assess the dental therapist's motivations for joining and expectations. Dental therapists were asked to rate the relevance of each factor on a Likert-type scale. The fourth part of the questionnaire (questions 13-24) solicited information about future job change and the identification of factors affecting the response. The fifth part of the questionnaire (questions 15-17) was related to job satisfaction.

Backstrom and Hursh (1963) and Babbie (1973) indicated that there are two basic forms of questionnaires: structured and open-ended. According to these authors a structured questionnaire is preferable so that the respondent does not deviate from the

intention of the questions. The questionnaire contained both forms of questions. Open-ended questions were used where the kinds of responses the question would elicit could be quite varied.

Though the questionnaire was constructed with due consideration to clarity and purpose, it was pre-tested to determine if there were ambiguities and to determine the time required to complete it. The pre-test was in two parts. The first part consisted of having the questionnaire critiqued by the Questionnaire Design and Resource Centre of Statistics Canada. This process is one of several requirements of Public Servants set forth in the Treasury Board Policy on Government Information Collection and Public Opinion Research. The critique was favourable and resulted in only minor adjustments.

The second pre-test was done using seven faculty members of the National School of Dental Therapy. Three of the faculty were graduate dental therapists with past field experience. The other four faculty members were dentists with several years of experience in training and field evaluation of dental therapists. The faculty participants were asked to critique the survey form in addition to responding to the specific questions. The recommended changes were minor, consisting primarily of replacing certain words and phrases with other words and phrases more familiar to dental therapists.

A mailing list of active dental therapists was obtained from the National School of Dental Therapy. A questionnaire along with a letter explaining the purpose of the study (Appendix A) and a letter from the President of the Canadian Dental Therapists

Society supporting the study (Appendix A) was mailed directly to each active dental therapist. A stamped, self-addressed envelope was included for the return of the completed form.

Six weeks later a follow-up letter (Appendix A) and another questionnaire and a stamped, self-addressed envelope were sent to those who had not responded.

Of the 66 survey forms mailed to dental therapists, 64 were returned, for a 92.5% return. Only two of the returned survey forms were unusable, a 90% return rate from the original 66 survey forms. The two unusable surveys came from dental therapists who were not engaged in direct service delivery to client groups.

Financial and Personnel Records

The financial records of the National School of Dental Therapy for fiscal years 1982/1983 through 1987/1988 and financial data available from Financial Services, Corporate Management Branch, Health and Welfare Canada, were used to extract training costs and certain operating costs related to training activities such as cost of supplies and equipment and cost of student dental therapist field clinics.

Additional operating costs (i.e., salaries and fringe benefits) were obtained from personnel records of Health and Welfare Canada and the Government of the Northwest Territories. The information obtained for individual dental therapists included classification of the position, salary adjustments, isolation post allowance, weekly scheduled hours, leave without pay, and maternity leave. This information was transferred to coded log sheets (Appendix L) in order to maintain the confidentiality of all concerned. No one other than the researcher had access to linked information.

Dental Therapists Monthly Work Summaries

The Dental Therapists Monthly Work Summaries (Appendix M) were used to calculate the economic benefits of the dental therapy program. The work summary is a detailed listing of certain dental procedures and services performed by dental therapists and provides monthly and cumulative totals of their occurrences. The monthly work summaries of each dental therapist in Group Two were obtained from the National School of Dental Therapy. The data on the work summaries are raw and were used to quantify the outputs of the dental therapists in Group Two. Annual work summaries by Regions for the years 1978-1988 were also obtained for use in the quality of care assessments.

Provincial Dental Fee Guides

Information from various provincial dental fee guides was used in association with the dental therapist's monthly work summary to calculate the market value of the kinds of services provided by dental therapists in Group Two. The fee guides used in this study were those published between 1984 and 1990 for the Yukon Territory, Northwest Territories, British Columbia, Alberta, Saskatchewan, Manitoba, New Brunswick, Nova Scotia, and Newfoundland. Entire copies of the more recent fee guides were obtained from government offices and libraries. Information from earlier fee guides was obtained by phone from the various provincial dental associations.

The following statement taken from the 1990 Suggested Fee Guide for Dental Services for the province of Newfoundland is consistent with information found in the preface of all dental fee guides used in this study:

> This guide is based on the provision of dental services which are performed under normal condition and is intended to serve only as a reference for the general practitioner to enable him (sic) to develop a structure of fees which is fair and reasonable to the patient and to the practitioner. The guide is not obligatory and each practitioner is expected to determine independently the fees which will be charged for the services provided (Newfoundland Dental Association: Suggested Fee Guide for Dental Services Provided by General Practitioners, 1990, p. i).

One of the assumptions of this study is that the suggested fees for dental services published in each province represent the regular fee of each dentist in that province.

Crawford and Holmes Study

Doctors P. Ralph Crawford and Bradley W. Holmes, both past presidents of the Canadian Dental Association, were contracted by Medical Services Branch, Health and Welfare Canada, to assess the technical perfection of dental restorations placed by dental therapists and dentists. The two researchers evaluated restorations placed by dental therapists and dentists on Baffin Island, Northwest Territories. A total of 323 patients were inspected in 5 Baffin communities. A total of 1,459 amalgam restorations, 355 composite restorations, and 46 stainless steel crowns, all placed within the preceding 18 months, were assessed by rating the quality of certain features such as marginal adaptation and anatomical form (Appendix I). All restorations were rated as either "superior", "satisfactory" or "failed". The results submitted by the researchers were in the form of frequency counts and percentages and did not include any other statistical comparisons. The ownership of the study and report resides with Medical Services Branch, Health and Welfare Canada.

Statistical Analysis

As discussed earlier, the present study was conducted in three separate but interrelated phases related to the training and utilization of dental therapists. Each phase of the study investigated different research questions. To obtain the necessary data to answer the research questions, four different study groups were used. The four groups do not correspond exactly with the three phases of the investigation (see Table 8). Rather, they represent four means of obtaining all the data needed to answer the research questions. Pertinent statistical tests were used to analyze information originating with each group.

Group One

The first group employed in this study is the group of dental therapists providing data for the economic analysis. This group consisted of the 32 dental therapists who graduated from the National School of Dental Therapy between 1984 and 1987 and who were subsequently employed as dental therapists in Indian and northern communities.

Although the dental therapy program began in the fall of 1972 with the in-take of the first class, this investigation covers only the period from July 1982 through June 1990. July through June were selected as time frames because the National School of Dental Therapy is funded on a contractual basis from July of each year through June of the following year.

In 1979 Rees and Jutai made a hypothetical analysis of the cost and benefits of the dental therapy program. The appraisal was built on theory and assumptions, underpinned with estimates based on available data on small sample findings and extrapolations drawn from them. It was the conclusion of these researchers that a dental therapy position would pay for itself in a little over two years. Accordingly, in accounting for the time line used in this study, an assumption was made that a dental therapy position would pay for itself within three years.

A composite of 32 dental therapists, representing four successive graduating classes, from 1984 to 1987, were selected for follow-up. It was felt that this group and the time period were of sufficient size and duration to provide a representative sample of overall program costs and benefits, taking into account attrition, term positions, maternity leave, other leave without pay, and downtime.

Since the training program for dental therapists is carried out over a two year period, program costs were calculated from 1982, when the class of 1984 entered training. Figure 16 depicts the time lines associated with the study.

Calculations of costs and benefits were based on the following equations drawn from the conceptual framework discussed in chapter IV:

Costs = Training costs + Employment costs + Delivery Costs

Benefits = Cash value of dental services produced by dental therapists.

Costs and benefits were compared by calculating the net present value. For calculation of net present value, net present costs were subtracted from net present

benefits. The decision rule is that the net present value should be greater than zero for the investment to have been worthwhile. The equation is stated as follows:

Benefits - Costs = NPV > 0

Applying the variables to the above equation the following mathematical model is produced:

$$\text{Cash value of dental services produced by dental therapists} - \left(\text{Training Cost} + \text{Employment Cost} + \text{Delivery Cost}\right) = \text{NPV} > 0$$

Measurement of Benefits

The economic benefits of a program are measured by calculating the value of increased revenues and the value of costs avoided (Carnevale & Shulz, 1990; Kober, 1982; Spencer, 1984). Since some or all of the costs of dental care for eligible registered Indians and Inuit are paid by the Federal Government, and since dental therapists are representatives of the Federal Government, no revenue in cash or kind is collected by them for services rendered. If the services are rendered instead by a private dental practitioner, the costs of the services are paid by Non-Insured Health Benefits Program of Health and Welfare Canada on behalf of the Federal Government. The economic benefits of the dental therapy program were thus calculated on the basis of avoided costs to the Federal Government.

The procedure for measuring benefits is to translate dental therapists' work outputs into market value. Two data sources were used in this exercise: the Annual Work Summary for each of the 32 dental therapists forming the study group, and the Sug-

gested Fee Guide for Dental Services for the province or territory and year in which the dental services were provided.

The Annual Work Summary is a listing of recognized dental procedures performed by each dental therapist in a given year and the number of these occurrences (Appendix M). The Suggested Fee Guide for Dental Services is a listing of dental procedures, grouped into clinical services, provided by dental practitioners and certified dental specialists, followed by a proposed fee structure which is considered to be fair and reasonable to the patient and to the practitioner. The fees stated in the fee guide are not obligatory. For the purposes of this study it was assumed that the published suggested fees represent a very close approximation of the actual fees charged by dentists.

Obtaining a complete fee guide from each province and territory for each year represented in the benefits time line was problematic. A complete fee guide for all provinces and territories was obtained for the years 1989 and 1990. These were obtained through the offices of the Regional Dental Officers, from the National School of Dental Therapy, and from the Senior Dental Consultant at the headquarters office. Fee guides for some of the remaining years were obtained from various sources, and represented a random assortment of fee guides for different provinces for different years.

In several of the fee guides, the suggested fee for each dental procedure was determined using the Relative Value System. In this approach, the input into a dental procedure is measured in terms of time factors and the degree of responsibility

involved. The result is that each dental service is assigned a relative scale of values. The unit of service is termed a Relative Value Unit (RVU). For example, a routine elementary procedure limited in variation of technique would be rated as one RVU, a more time consuming procedure may be two RVUs, a more time consuming and complicated procedure may be rated as three or more RVUs. For general practice the basic unit of service (one RVU) is generally considered to be a one-surface amalgam, primary tooth. Thus, a dollar value for each dental procedure is obtained by multiplying the relative value of the procedure by the selected dollar value of a one-surface amalgam, primary tooth (e.g., if a one-surface amalgam, primary tooth = one RVU = $25, then the more time consuming procedure assigned a value of two RVUs, would cost $50).

Since it was not possible to obtain fee guides for all locations for all years, the Relative Value System, as described above, provided a means of arriving at a formula for measuring the cash value for each dental procedure for each year. This was achieved in two steps. First, the suggested fee for a one-surface amalgam, primary tooth, for each year in the benefits time line was obtained from the available dental fee guides and from the provincial dental associations by telephone (Appendix N). Second, using the 1990 suggested fee guide for each province and territory employing dental therapists, the fee for each dental procedure performed by dental therapists was calculated as a percent of a one-surface amalgam, primary tooth (Appendix N). The resulting ratios became the basis for calculating the benefits for any given year. The translation of the ratio for any given procedure into a fee was accomplished by

multiplying the ratio assigned to the procedure by the suggested fee for a one-surface amalgam, primary tooth, for the year under review.

Although the ratios were calculated using the 1990 fee guides, it is believed that the ratios represent a reasonable relationship between all services within a given year. If they are biased, the bias would be in the form of a downward compression on benefits since, over time, technology and dental techniques tend to improve. The result is, for example, that a procedure which may have been worth 1.5 or 2 RVUs in 1984 is less in 1990.

The market value of dental services provided by dental therapists in each year in the benefits time line was calculated by obtaining from their respective Annual Work Summaries the dental procedures performed and the frequency of occurrence. The frequency count was multiplied by the ratio assigned to the procedure. The resulting figure was multiplied by 1 RVU for that year (i.e., suggested fee for one-surface amalgam, primary tooth). For example, in the province of Newfoundland, if in 1990 a dental therapist provided 100 topical fluoride treatments the market value would be .35 X 100 X $28 = $980. The cash value of all procedures performed were totalled and transposed to the coded log sheets (Appendix M).

Dental therapists routinely provide group instruction (health education) in the schools and in the community (e.g., prenatal classes, postnatal classes, well-baby clinics, etc.). The cash value of the time spent by dental therapists on health education was obtained by converting health education time to Oral Health Instruction (OHI) time units as defined by the dental fee guide and multiplying as above.

Measuring Costs

Koehler and Slighton (1973) provided a review of the state of the art of cost and activity analysis in the medical school. It was the opinion of these researchers that if the research question to be answered is whether an on-going program is "paying for itself," the appropriate cost accounting procedure is pure costs, that is, assigning costs to individual products or processes such that the sum of cost assignments equals total costs. Costs in this sense deal with program inputs and refer to the total money - expenditures required to achieve something (Mills & Drummond, 1985). Calculating the cost of the dental therapy program thus involved enumerating and valuing the resources consumed. The cost of the dental therapy program was based on measurements of the training costs, employment costs, and delivery costs of the program.

Training Costs

The National School of Dental Therapy is operated on a contractual agreement between Medical Services Branch on behalf of Health and Welfare Canada and the University of Toronto School of Dentistry. The cost of training dental therapists (i.e., personnel costs, equipment, supplies, materials, etc.) is contained within the budget for operating the National School of Dental Therapy. Thus, training costs of dental therapists is the direct cost of institutional training.

The National School of Dental Therapy has two major functions (1) training dental therapists, and (2) operating a field support program which consists of the provision of supplies and services to graduate dental therapists. Examples of supplies and services

for graduate dental therapists are the replenishing dental supplies and replacement of dental equipment; quality control of graduate dental therapists through technical support and on-site evaluations; providing graduate dental therapists with treatment plans; and refresher courses for graduate dental therapists.

The University of Toronto keeps accounts and records of all expenditures and commitments made by the School. Since cost-benefit analysis was not initially built into the project design, the financial coding used by the University does not distinguish between training expenditures and field support expenditures. In most instances these are shared costs, involving the same personnel, common supplies and equipment, etc. Subsequently the apportionment of funds between training and field support was at times unclear in the financial information provided.

The uncertainty created by unclear apportionment of funds is simple and clear cut. The objective of this exercise was to avoid concealment of the problem and to employ valid estimates of training costs as far as possible.

The measurement of training costs were based on the following equation drawn from the conceptual framework provided in Chapter IV:

Direct cost of institutional training	-	Cost of Non-training Supplies	-	Cash value of dental services produced by trainees	=	Net Training Cost

The net training cost of dental therapists in the study group was derived from the operating budget of the National School of Dental Therapy. The annual operating budget of the School is divided into three expenditure categories: Salaries and Benefits, Operations and Maintenance, and Capital (Appendix O). Direct cost of institutional train-

ing is the portion of the operating budget committed to training and training related activities. The cost of non-training supplies was taken as the cost of consumable dental supplies provided to graduate dental therapists by the National School of Dental Therapy and reimbursed by the Regions (administrative centres). The cash value of dental services produced by trainees is the cash value of dental services rendered by students during the field clinic portion of their training.

In attempting to separate training costs from the operating budget of the National School of Dental Therapy, the only valid estimate possible for training costs was for salaries and benefits. A study of staff time distribution for training and non-training responsibilities revealed that overall 61 percent of staff time is devoted to activities related to the training of dental therapists, and 39 percent of the time is devoted to other activities beyond training responsibilities (Appendix P). It was felt that these figures are representative of staff time distribution throughout the training cost time line.

The operation and maintenance (O & M) budget includes both training and non-training expenditures. It was not possible to make any defensible estimate of what portion of the expenditures were devoted only to the activity of training dental therapists. For example, travel is a significant component of the O & M expenditures. Travel costs include the costs associated with the field clinical training of student dental therapists (training cost), travel for evaluation and supervision of graduate dental therapists (non-training cost), attendance at conferences (training and non-training costs), and other travel related to the business of the school (training and non-training cost). In most cases it would be difficult to separate these costs without examining in detail each individual

invoice and travel claim and discussing them with the claimant. Likewise, it was not possible to separate training costs and non-training costs from expenditures related to telephone, computer services, office supplies and equipment, and postage and freight.

Capital expenditures cover the acquisition of capital assets such as vehicles and equipment. It was not possible to determine which portions of the capital budget were training expenditures and which portions were non-training expenditures since, in most instances, capital costs were shared costs. Moreover, contained within the capital budget are the total expenditures for equipment purchases with no allowances being made for future use of the equipment in training dental therapists in subsequent courses beyond the training cost time line in this study. No means could be found for arriving at a "best feasible" cost estimate of the training portion of the capital expenditures.

It is clear from the above that the direct costs of institutional training, as compiled in this study is an overestimate of the actual cost since no *ex post facto* arrangements could be made to disaggregate the data.

A major expenditure item of the School is the cost of consumable dental supplies for the field operation of the dental therapy program. The School produces a quarterly statement of supply costs by Region (administrative centre) and by dental therapist. Since the cost of these supplies are recoverable from the various Regions, it was deducted from the cost of institutional training.

In addition to classroom work, all students nearing the successful completion of their second year must complete a 6-7 week working field clinic located in a selected remote northern community. Health and Welfare Canada benefits monetarily when a student

provides a service that would normally be performed by a dental practitioner and billed to Health and Welfare Canada under the Non-Insured Health Benefits Program. The dental services produced by students thus provide a direct benefit to Health and Welfare Canada in the form of cost avoidance. Accordingly, the direct cost of institutional training was further off-set by the cash value of student services.

A record is maintained by the National School of Dental Therapy of the total number of each type of dental service provided by students during the field clinic. The cash value of services produced by students was determined following the procedures described in the section "Measurement of Benefits" above.

Employment costs

Upon successful completion of the dental therapy training program, graduate dental therapists are offered employment in an Indian or northern community. Employment costs typically include hiring costs, salary and fringe benefits, cost of supplies, and employer paid continuing education. Hiring costs for each of the 32 dental therapists in the study group could not be ascertained on a national basis without placing large demands on several regional offices resulting in considerable time and expense. Generally, most dental therapists are single persons and free to relocate with minimal disruption. Travel costs vary with distance from place of recruitment to place of employment. Removal of personal effects varies for each individual therapist, depending on what managers are willing to pay. Since most of the newly hired dental therapists are single and assuming they have no more than 1,000 pounds of personal effects for removal, it is safe to assume that hiring cost will average $3,000 for each of the 32 dental

therapists in the study group.

The annual gross salary for dental therapists was derived by dividing the annual rate of pay, as stipulated in the Collective Agreement, by the number of working days in a calendar year (260.88) to obtain the daily rate of pay. The daily rate of pay was multiplied by the number of days of continuous employment in each calendar year.

No information on fringe benefits was collected except for isolation post allowance. The absence of these values from the calculation under-represents the employment costs. However, this is greatly offset by the inclusion of isolation post allowance which is considered the "big ticket" fringe benefit item. Most dental therapists are entitled to isolation post allowance which ranges from $1,000 to $10,000 per annum, depending on the degree of isolation.

Continuing education of graduate dental therapists may take a variety of forms ranging from attendance at the local Zone Conference to leave without pay to pursue additional studies. The most common form of continuing education for most dental therapists is a refresher course provided by the National School of Dental Therapy, generally every second year, but sometimes more frequently. The cost of continuing education is contained in the O & M budget of the National School of Dental Therapy. Since the full amount of the O & M budget of the School is included in the calculation for net training costs, the cost of continuing education is not lost from the overall cost analysis. The cost of continuing education in the O & M budget from 1982-1987 is for all dental therapists and not just members of the study group. It is therefore believed that these costs more than adequately reflect the cost of continuing education for the study

group between 1988 and 1990.

Delivery Costs

Delivery costs typically consist of the cost of reaching the target population and of delivering the services (Austin, 1978). Costs of reaching the target population normally include the travel costs of dental therapists to reach the target population and the cost of duty travel of staff from the National School of Dental Therapy and zone or regional offices to provide on-site evaluation and supervision and to produce treatment plans for the dental therapists. The cost of delivering services is taken as the variable costs of supplies, instruments, and equipment employed by dental therapists.

Once again, travel costs of dental therapists could not be ascertained without a laborious search of files located in a wide assortment of offices across Canada. According to Austin (1978), one guideline in allocating costs is that a cost should not be attributable to an activity if it would have been incurred anyway. It is defensible to suggest that these travel costs, and much more, would have been incurred, in the absence of dental therapists, in the form of travel costs paid for dental teams to visit these communities once or twice a year and/or the costs of transporting patients to a service centre to receive treatment. It is worthwhile to point out that travel costs of dental teams and the transportation of dental patients are major cost items to Non-Insured Health Benefits. Therefore, the omission of dental therapists' travel costs from the analysis is justified.

As stated earlier, it was not possible to separate out the cost of duty travel of staff from the National School of Dental Therapy from other travel. Therefore, this cost could

not be identified. The omission of staff duty travel costs is counterbalanced by the fact that the direct costs of institutional training in the section above on training costs is inflated by the inclusion of duty travel costs for non-training activities of the staff, which includes annual duty travel to all graduate dental therapists, because they could not be disaggregated from other costs. The omission of duty travel cost of the staff of the National School of Dental Therapy is considered justified.

Duty travel costs of zone/regional dental managers are discounted in the same way as duty travel costs of dental therapists. The travel costs of dental teams to visit communities and/or patient travel costs to service centres to receive dental treatment are sufficiently high to counterbalance, in the country as a whole, the duty travel costs of dental therapists and zone/regional dental managers.

The cost of delivering services to the target population varies with the kind and level of services rendered. The variable cost of consumable supplies used by individual dental therapists in the delivery of services is recorded and calculated quarterly by the National School of Dental Therapy. These quarterly figures were tallied for each dental therapist in the study group and transposed to the coded log sheet (Appendix L). Any funds spent by regions on additional supplies were not recorded. Because of the extensive standardization of the dental therapy program in every respect including supplies, equipment, and instruments, and strong role taken by the School in enforcing the standardization, it was felt that the figures produced by the National School of Dental Therapy are a very close approximation of the actual cost of supplies, equipment, and instruments consumed by dental therapists.

Treatment of Time

Past costs and benefits of the program are not treated as being of the same value as present costs and benefits. Costs and benefits occurring over different time horizons were made compatible by adjusting all yearly totals to 1982 and 1990 dollars. The Consumer Price Index (CPI) (Appendix Q) published by Statistics Canada was used to adjust actual dollars to 1990 dollar values.

Costs and benefits occurring in different years were adjusted to 1982 dollars by dividing cost and benefit data for any given year by the inflation factor for that year and each succeeding year so that the first year of the analysis was the base year (1982). Cost and benefits occurring in different years were adjusted to 1990 dollars by multiplying cost and benefit data for any given year by the inflation factor of that year and each succeeding year so that the last year for analysis was the base year (1990). From 1982 to 1990 there was a 36.50 percent increase in the Consumer Price Index.

Group Two

Group Two consists of the dental therapists involved in the Crawford and Holmes (1989) assessment of dental treatment in the Baffin Region. In this study the technical quality of dental restorations completed by dentists and dental therapists was categorized as "superior", "satisfactory", or "failed". The report submitted by the researchers was in the form of frequency counts and percentages for each of the three categories of technical quality. One of the limitations of the report was its failure to make maximum use of the data collected. Therefore, the statistical analysis of these data was under-represented.

The application of additional statistical techniques by the present researcher and here described serve to more accurately communicate the nature of the findings and how seriously to regard the apparent differences found between dental therapists and dentists.

Although a perusal of the percentage distribution of results for dental therapists and dentists appears significant, a chi-square test of significance was applied by the present researcher. The statistic chi-square (χ^2) is a measure of discrepancy existing between observed and expected frequencies (Borg & Gall, 1983). If $\chi^2 = 0$, there is complete agreement between observed and theoretical frequencies. If $\chi^2 > 0$, they do not agree exactly. The larger the value of χ^2, the greater is the discrepancy between observed and expected frequencies.

The main advantage of the Crawford and Holmes study was its categorization of individual providers into mutually exclusive classes or categories of care for various categories of service. The categories of "superior", "satisfactory", and "failed" are mutually exclusive and since there was no attempt to weigh the differences, each category differs only in definition. Keppel and Saufley (1980) state that when the information afforded by the chi-square test, as in the present study, is based on the classification of subjects into categories or attributes, a significant chi-square test can only lead to the conclusion that a significant relationship exists between the two variables. Accordingly, although the results of the chi square test will render an overall verdict on the relationship of the variables in this particular study, it does not permit a comparison of the efficiency of the performance of service providers for different categories of service. Thus it is possible to get an overall significant difference when some of the observed differences do not reach

statistical significance.

According to Mudget (cited in Spitzer, Roberts, & Delmore, 1976), a weighed index is a usual procedure to create compatible measures of output for goods and services of variable complexity. Since classifying restorations using ordinal measures of "superior", "satisfactory", or "failed" represents an order of decreasing value or weight, assigning a numerical weight to each value label and multiplying by the frequency of its occurrence would convert the category-variables of "superior", "satisfactory", and "failed" into quantity-variables. This procedure will produce a score and thus provide access to an arithmetic mean and standard deviation which will permit the inference of parametric values in the population based upon the statistics in the sample, using the concept of standard error (Rowntree, 1981).

Based on experiences reported in the literature (Ambrose, Hord & Simpson, 1976; Romcke & Lewis, 1973), a scoring scale was devised for grading the performance of dental therapists and dentists in the Crawford and Holmes Study. A restoration of "superior" quality was scored as a 3; a restoration labelled "satisfactory" was scored as a 2; and restorations rated as "failed" were given a score of 1. This permitted the quantification of findings for each dental procedure for each service provider.

In this investigation a *t*-test of independent groups was applied to test the statistical significance of the difference between the mean scores of dental therapists and dentists on each type of clinical restoration. In order to accept differences as statistically related, the statistical probability for each variable was set at or below $p < .05$.

Group Three

The subjects in Group Three were all dental therapists employed in Indian and northern communities between 1978 and 1988. The annual work summaries of each dental therapist were analyzed and data extracted to provide additional insight into the overall quality of dental care provided by this group between 1978-1988.

Two general indices for evaluating the quality of care based on patterns of treatment are the ratio of restorations to extraction and the ratio of restorations to preventive work. The first ratio is a recognized method for evaluating the quality of third-party payment systems. The second ratio is an index to the degree to which dental health has improved in the community as a whole. The dental therapists' annual work summaries provided the required data. For the purposes of this study restorations were defined as all amalgam restorations. Extractions were all extractions, primary and secondary teeth. Preventive work was defined as oral hygiene instruction, scaling, fluoride treatment, polishing and pit and fissure sealants.

The ratio of restorations to extractions is calculated by dividing the total number of restorations by the total number of extractions in a given year. A favourable finding is steadily increasing ratios. The ratio of restorations to preventive work is calculated by dividing the total number of restorations by the total amount of preventive work. The desirable results are steadily decreasing ratios.

Each ratio was subjected to a secular trend analysis using the least-squares method "best fitting" trend line. Secular trend analysis is a way of predicting future patterns based on past performances. The relationship between the two ratios was examined using

Pearson's Product Moment Correlation Coefficient.

Group Four

Group Four is the surveyed population. This group consisted of all dental therapists employed at the time in Indian and northern communities. The survey data were coded and then analyzed using DESCRIPTIVE, FREQUENCIES, MEANS, CORRELATION, CROSSTABS, ONEWAY, and T-TEST subroutines of the Statistical Package for the Social Sciences (1990). In order to be accepted as significantly related, the statistical probability for a variable must be at or below $p < .05$. Data derived from the survey were used to answer questions related to all three problem statements. The statistical analysis for the first and second problem statements have been discussed in the preceding sections of this chapter.

The third problem statement for this study was: What is the relationship between dental therapist demographic variables and dental therapists' predisposition and sentiments toward their work experience? To answer this question several subquestions were generated, with null hypotheses for acceptance or rejection at the $\alpha = .05$ level.

1. Are the motivational factors which seemed important to dental therapists in choosing a career in dental therapy being satisfied by the subsequent job experience? This question was answered by calculating the mean score for the importance each motivational factor and the mean scores for the same factors relative to job experience and expectations. The SPSS subprogram MEANS was used for calculations. The two sets of scores were presented and compared on a dual Y axis.

2. Is there a difference in the ratings of native and non-native dental therapists for job security? The question was answered using the *t*-test of independent means. The null hypothesis was: there is no difference in the ratings of native and non-native dental therapists regarding job security. The analysis and significance of the finds were reported by SPSS subprogram T-TEST.

3. Is there a relationship between the respondents' ratings for job security and the ratings assigned to dental therapy as a "good career opportunity"? This question was answered by calculation of the Pearson's Product Moment Correlation Coefficient. The null hypothesis was: there is no relationship between dental therapists' scores for job security and the ratings they assigned to dental therapy as a "good career opportunity". The correlation and significance of the correlation were reported by SPSS subprogram CORR.

4. Is there a difference in the ratings of native and non-native dental therapists regarding dental therapy as a "good career opportunity"? The question was answered using the *t*-test of independent means. The null hypothesis was: there is no difference in the ratings of native and non-native dental therapists regarding dental therapy as a "good career opportunity". The hypothesis was tested using SPSS subprogram T-TEST.

5. Is there a difference in the ratings of male and female dental therapists regarding dental therapy as a "good career opportunity"? The question was answered using the *t*-test of independent means. The null hypothesis was: there is no difference in the ratings of male and female dental therapists regarding dental therapy as a "good career opportunity". The analysis and significance of the findings were reported by SPSS subprogram

T-TEST.

6. Are there differences in the ratings of dental therapists from different educational backgrounds regarding dental therapy as a "good career opportunity?" The question was answered by calculating the analysis of variances. The null hypothesis was: there are no significant differences in the perceptions of dental therapists of varying academic preparation with regard to dental therapy as a "good career opportunity." The analysis of the variance and the significance of the findings were reported using SPSS subprogram ONEWAY.

7. Are there differences in the number of years respondents have been a practicing dental therapist and the ratings given to dental therapy as a "good career opportunity?" The analysis of variances was employed to answer the question. The null hypothesis was: there is no difference in the experiential levels of dental therapists and their ratings of dental therapy as a "good career opportunity". The analysis and significance of the findings were reported by SPSS subprogram ONEWAY.

8. Do dental therapists who state a likelihood of leaving their positions in two years time also tend to score job security low? The question was answered by calculating the Point Biserial Correlation Coefficient (r_{pb}). According to Fitz-Gibbon and Morris (1978), Point Biserial is the appropriate correlation coefficient to use when one measure is dichotomous and the second measure is interval. The null hypothesis was: there is no significant correlation between ratings of job security and indication of future job change.

9. Is there a tendency for dental therapists who indicate a future job change to also score dental therapy as a "good career opportunity" lower? This question was answered

by calculating the Point Biserial Correlation Coefficient (r_{pb}). The null hypothesis was: there is no significant correlation between indications of future job change and "good career opportunity".

10. Is there a relationship between ethnicity of dental therapists (native/non-native) and indication of future job change? This question was answered by calculating the Phi Coefficient (ϕ). According to Fitz-Gibbon and Morris (1978), the Phi Coefficient is the appropriate correlation coefficient to use when both measures are dichotomous. The null hypothesis was: there is no relationship between ethnicity of dental therapists and indication of future job change. The correlation and the significance of the correlation was reported by SPSS subprogram PHI.

11. How satisfied are dental therapists with their present job? This question was answered by calculating the group average score for five factors related to job satisfaction. The SPSS subprogram MEANS was used for the calculations.

Summary

The present study was conducted in three separate but interrelated phases related to: the economic efficiency of the dental therapy program, the quality of dental care provided by dental therapists, and an examination of dental therapists' predisposition and attitudes toward their work experience. To obtain all the necessary data to answer the research questions associated with each phase, four different study groups were used. Different methods and instrumentation were used with each group. Pertinent econometric techniques and statistical tests were used to analyze data originating with each group.

CHAPTER VI

RESULTS AND DISCUSSION

The major research question guiding the present study is: From the viewpoint of Health and Welfare Canada, what are the costs involved in the training and utilization (employment) of dental therapists to provide basic dental care services in Indian and northern communities and how does this compare with the results obtained? To answer this question, the study developed the investigation into three interrelated phases related to training and service delivery. These stages focused on the economic analysis of the dental therapy program, the quality of care provided by dental therapists, and factors related to the predisposition and sentiments of dental therapists toward their work which are believed to be associated with costs and benefits of the program.

A survey questionnaire was used to obtain the data on predisposition and sentiments of dental therapists toward their job and some of the data on quality of care. At the time of the survey there was a total of 66 active dental therapists employed throughout Canada. Sixty-four of the 66 dental therapists returned finished questionnaires. The total number of usable questionnaires was 62. This final figure yielded a response rate of 90 percent.

In the present chapter the demographic characteristics of the dental therapists are presented followed by the results of the economic analysis, quality of care study, and the statistical analysis of the survey data.

Demographic Characteristics

Ethnicity. Dental therapists are trained to provide dental health care to status Indians and Inuit people, as well as all residents of the Yukon and Northwest Territories. Qualified Indian and Inuit people are particularly encouraged to consider dental therapy as a career choice. Respondents were asked if they were a member of one of the Aboriginal peoples of Canada. Twenty-nine percent of the respondents (see Table 9) identified themselves as individuals of native ancestry (Indian, Inuit, Métis). Statistics are not readily available on native respresentation in other health careers, particularly in dental health careers. However, the general consensus is that the dental therapy program is successful in attracting and keeping skilled native operators. This researcher was also informed by the National School of Dental Therapy that one native dental therapist (not in the surveyed population) eventually entered dental school and subsequently became the first lady dentist of Indian ancestry in Canada.

Sex. Female dominance characterizes the sex distribution of dental therapists (Table 9). Females made up 61.3 percent of the respondent group, while males totalled only 38.7 percent. Employing nonparametric procedures through SPSS CROSSTABS, no significant relationship was found to exist between ethnicity and sex ($\chi^2 = .30$, $df = 1$, $p = .57$).

Age. The ages of dental therapists ranged from the categories 20-24 to 45-49. Eighty-four percent of the respondents were 39 years old or under, indicating a potential for many more years of productive service as a dental therapist (Table 10). No respondents were in the age categories 50-54 and 55+. Indeed, the population of

dental therapists is a relatively young one.

Table 9
Distribution of Respondents by Ethnicity and Sex

	Native	Non-Native	
Male	6	18	38.7%
Female	12	26	61.3%
	29%	71%	

Table 10
Age of Respondents

Age	N	%	Cum %
20-24	7	11.3	11.3
25-29	17	27.4	38.7
30-34	9	14.5	53.2
35-39	19	30.6	83.9
40-44	7	11.6	95.2
45-49	3	4.8	100.0
50-54	0	-	-
50+	0	-	-

Geographical Distribution. Table 11 shows the geographical distribution of respondents by region and by type of community. The Northwest Territories has the largest number of dental therapists, representing almost one-third of the respondents. Pacific Region (British Columbia) has the second largest concentration of dental

therapists, accounting for 18 percent of the respondents. Alberta and the Yukon followed with 12.9 percent each of respondents. The two territories (Yukon and Northwest Territories) account for 46.8 percent of the population of dental therapists. The 4 dental therapists reported for Saskatchewan do not include 3 dental therapist instructors employed at the National School of Dental Therapy in Prince Albert.

Respondents were asked to classify the community in which they live as "urban", "rural", or "remote". Seventy-four percent of the respondents reported living in rural or remote communities. This does not represent the distribution of communities in which they work. For example, 7 of the 8 respondents in the Yukon live in Whitehorse which, by definition, is an urban community. However, they serve all of the 16 rural and isolated communities in the Yukon.

Table 11
Geographical Distribution of Respondents

Geographical Location

	N	%
Atlantic	4	6.5
Manitoba	6	9.7
Saskatchewan	4	6.5
Alberta	8	12.9
Pacific	11	17.7
Yukon	8	12.9
N.W.T.*	21	33.9

*Northwest Territories

Type of Community

	N	%
Urban	22	35.5
Rural	17	27.4
Remote	23	37.1
	62	100.0

Education. It is informative to know the highest level of education attained by dental therapists, not including their qualifications as a dental therapist. The distribution of education among the dental therapists studied was skewed towards the completion of two-years post-secondary education and some or complete university education (62.9%). Thirty-five percent of the dental therapists report having some or a complete university education (Table 12). This latter finding is not surprising given the number of dental therapists who take educational leave or who report being enrolled in evening classes.

Table 12
Educational Attainment of Respondents

	N	%
High School		
Incomplete	2	3.2
Completed	20	32.3
Community College		
Incomplete	1	1.6
Completed	17	27.4
University		
Incomplete	16	25.8
Completed	6	9.7

Years of experience. The actual years of experience of dental therapists ranged from less than one year to over 7 years, with the greatest number reporting that they have been engaged in what is sometimes referred to as "wet-finger dentistry" for over seven years (Table 13). Over 59 percent of the dental therapists have five or more

years experience. This dispels the notion held in some quarters that there is a high attrition rate among dental therapists. Although this may have been the case in the early years of the program, the statistics in Table 13 suggest that dental therapists are remaining in their positions longer.

Table 13
Years of Experience of Respondents

	N	%
Less than one year	8	12.9
1 - 2 years	5	8.1
3 - 4 years	12	19.4
5 - 6 years	10	16.1
7 years or more	27	43.5

Economic Analysis

The evaluative judgement of the economic efficiency of training and employing dental therapists by Health and Welfare Canada is reached by comparing the program's benefits and costs using the net present value approach. The net present value is derived by subtracting the present dollar value of program costs from the present dollar value of program benefits. The decision rule is that the net present value should be greater than zero for the program to be worthwhile. The formula is:

Benefits - Costs = NPV > 0

The economic analysis was based on an intracohort trend study of 32 dental therapists trained and employed by Health and Welfare Canada between 1982 and

1987. The costs incurred and benefits accrued by individuals in the cohort were measured annually from date of entry into training, through graduation and appointment as dental therapists to date of termination, or June 30, 1990, which ever came first. The cost and benefit data for the entire cohort were aggregated on an annual basis, adjusted to 1990 dollars and totaled for comparison. The results of this analysis will allow inferences about the cost efficiency of training and employing dental therapists.

The following sections present the results of the benefits and costs data analyses and compare the two to obtain the net present value.

Benefits

Most of the dental services provided to registered Indians and Inuit by a dentist or dental practitioner are paid by Health and Welfare Canada through the Non-Insured Health Benefits Program. Dental care including dental check-ups, cleaning, fluoride treatments, x-rays, fillings, crowns and extractions are fully covered, given certain limitations. Dental therapists, trained and employed on behalf of Health and Welfare Canada, provide many of these dental services. The government benefits monetarily when dental therapists perform services that would otherwise be performed by a dentist or dental practitioner and billed to Health and Welfare Canada. The economic benefits of the dental therapy program were thus calculated on the basis of avoided costs to the Federal Government. The expectation is that over the life of the program, the sum of the avoided costs will exceed the operational costs of the program and the

program will be considered cost-beneficial to the Federal Government.

The cash value of the annual output of each dental therapist in the study group was calculated and transposed to their respective coded log sheet. The annual totals for all dental therapists in the study group were summed and adjusted to 1990 dollars. The results are reported in Table 14.

Table 14 shows the total explicit benefits, adjusted to 1990 dollar values accrued by the 32 dental therapists in the study group from the date of each therapist's appointment to their date of termination or to June 30, 1990, whichever came first. The time line for the benefits analysis was July 1, 1984 through June 30, 1990.

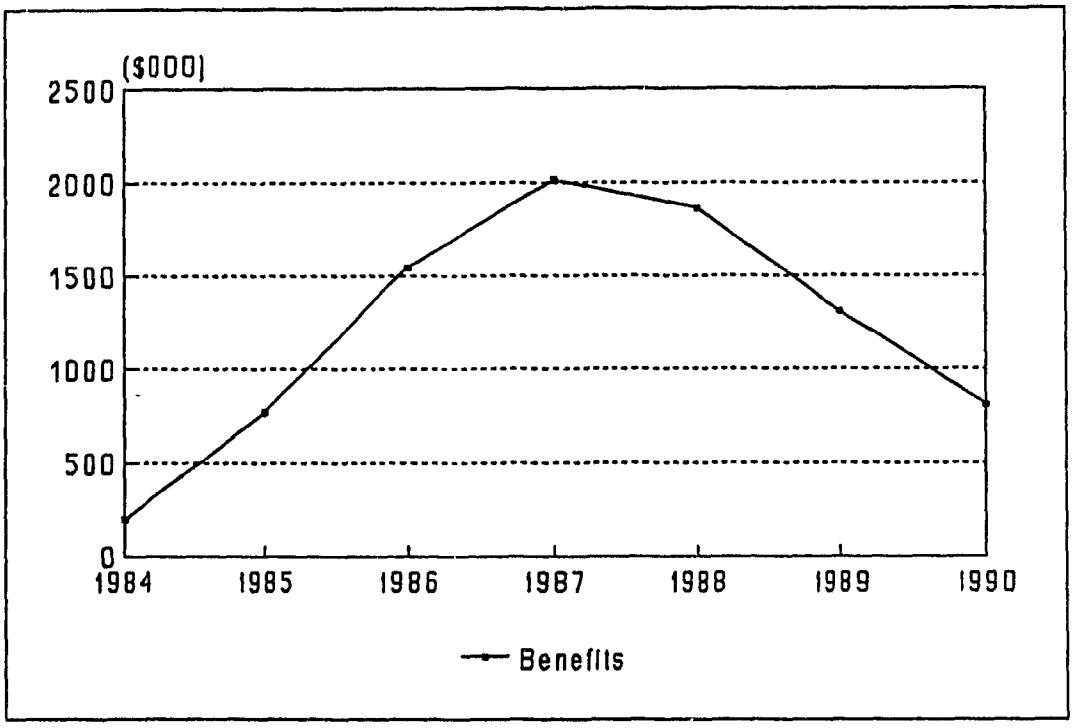
Table 14
Total Actual Dental Therapy Program Benefits Adjusted to 1990 Dollar Values

Year	Actual	Adjusted
1984	156,512	202,460
1985	620,986	772,355
1986	1,294,788	1,546,974
1987	1,761,855	2,016,294
1988	1,694,444	1,864,566
1989	1,248,467	1,308,393
1990	811,086	811,086
Total	7,588,138	8,522,128

The relationship of the adjusted benefits to time is illustrated in Figure 17. The successive increase in benefits from 1984 through 1987 is a direct result of a steady increase in the overall number of dental therapists in the study group and, to a lesser

extent, a result of annual increases in the suggested dental fees. The decline in benefits following 1987 is explained by Table 15 which depicts the appointment and attrition of dental therapists in the study group.

Figure 17
The Relationship of Benefits to Time, 1984-1990



After the employment of the 1987 graduating class, no more dental therapists were added to the study group. The attrition began to occur in 1988 with 3 (one each from the appointees in 1984, 1985, and 1987); 2 in 1989 (one from the appointees in 1985 and one from the appointees in 1986); and 4 in 1990 (two from the appointees in 1986 and one each from the appointees in 1985 and 1988).

Table 15
Appointments and Attrition of Dental Therapist in the Study Group

	1984	1985	1986	1987	1988	1989	1990
Appointments	6	10*	7	8	1**	0	0
Attrition	0	0	0	0	3	2	4
Cumulative Total	6	16	23	31	29	27	24

* One appointee from the class of 1984
** Appointee from the class of 1987

Annual attrition of dental therapists from the study group between 1988 and 1990 accounts for the corresponding decrease in benefits from 1988 through 1990. Furthermore, benefits for 1990 were calculated for the first six months only. The benefits for 1990 appear to be greater than the proportional amount for the preceding year (see Table 14). This is a false projection since excluded from the 1990 benefits analysis are the months of July and August, when children are not in school. These months are typically the least productive for all dental therapists and are the months in which most dental therapists take annual leave. It can be expected that when the benefits analysis is calculated for the entire year, the inclusion of these two months will deflate the projected amount for that year.

Concealed in the figures in Table 15 are the variable proportions of dental therapists on leave without pay at some point during the study period as well as those employed part-time. This also exerted a downward compression on benefits.

Costs

Koehler and Slighton (1973) stated that if the research question to be answered is whether an on-going program is "paying for itself," the appropriate cost accounting procedure is pure costs, that is, assigning costs to individual products or processes such that the sum of cost assignments equals total costs. Costs in this sense deal with program inputs and refer to the total money expenditures required to achieve something (Mills & Drummond, 1985).

In the present study estimates of program costs were based on the following program input model drawn from the conceptual model provided in chapter IV: Program costs = training costs + employment costs + delivery costs.

Training Costs

The reader will recall that the measurement of training costs was based on the following equation drawn from the conceptual framework provided in chapter IV:

Direct cost of institutional training	-	Cost of non-training supplies	-	Cash value of dental services produced by trainees	=	Net Training Cost

The total cost of training dental therapists, including the field clinic or practicum portion of their training, is derived from the overall operating budget of the National School of Dental Therapy, which has both a training and non-training function. To ascertain the net training cost it was first necessary to approximate as close as possible the direct cost of institutional training. Table 16 shows the estimated direct cost of institutional training for each contract year between July 1, 1982 and June 30, 1987.

Table 16
Estimated Direct Training Costs of Dental Therapists, 1982-1987

Year	Salaries	+ O & M	+ Capital	= Direct Training Cost
1982 - 1983	313,693	182,654	107,827	(604,174)[1]
				469,910
1983 - 1984	347,853	399,664	57,449	804,966
1984 - 1985	374,413	551,816	150,465	1,076,694
1985 - 1986	403,151	499,674	162,473	1,065,298
1986 - 1987	415,874	504,674	198,975	(1,119,523)[2]
				602,820

[1] Shared costs for 9 student dental therapists: 2 who graduated in 1983 and 7 new students (study group) who graduated in 1984. Costs prorated for 7 dental therapists in the study group = $469,910.

[2] Shared costs for 13 student dental therapists: 7 who graduated in 1987 (study group) and 6 new students who graduated in 1988. Costs prorated for 7 dental therapists in the study group = $602,820.

Costs related to salaries and benefits at the National School of Dental Therapy were calculated as the portion of time devoted by staff to training dental therapists and other training related activities. Sixty-one percent of staff's time was used for training activities; therefore, 61% of the staff's salary was prorated to training. For example, the salary and benefits of staff in 1983/84 were reported to be $570,251 (Appendix 0). Sixty-one percent of $570,251 is $347,853.

Since no other *ex post facto* arrangement could be made to disaggregate training from non-training costs in the operations and maintenance and capital expenditures of the budget, the direct training costs represent an overestimate.

In order to make the direct cost of institutional training compatible in time with

other expenditures and program benefits, the direct training costs in Table 16 were prorated to calendar years (Table 17). The net training cost was determined by off-setting the prorated direct cost of institutional training with the annual cost of consumable dental supplies provided by the National School of Dental Therapy for the field operation of the dental therapy program since the cost of these supplies is reimbursed by the Regions. The direct cost of institutional training was further off-set by the cash value of the dental services provided by student dental therapists during the field portion of their training since these services represent a savings to Health and Welfare Canada in terms of fees chargeable by private dental practitioners. Table 17 shows the estimated annual net training cost adjusted to 1990 dollar values.

Employment Costs and Delivery Costs

Employment costs typically include costs of hiring, salary, fringe benefits, and employer paid continuing education. Hiring costs of the 32 dental therapists in the study group were estimated to average $3,000 per therapist. Since most of the employer paid continuing education is provided through the National School of Dental Therapy, this cost item was included in the operations and maintenance budget which forms part of the direct cost of institutional training (Table 16). Continuing education costs of the study group were not available for 1988-1990. This is counterbalanced by the fact that continuing education costs in the 1982 - 1987 operations and maintenance budget were for all dental therapists not just the study group. Salary costs in the present study are actual wages earned. Fringe benefits were calculated as isolation post allowance. No other information on fringe benefits was collected.

Table 17
Estimated Annual Net Training Costs Adjusted to 1990 Dollar Values

Year	Direct Cost of Institutional Training	- Non-Training Supplies	- $ Value of Students' Work	= Estimated Net Training Cost	= 1990 Dollar Value
1982*	234,955	85,663	132,212	17,080	24,404
1983	637,440	115,126	39,331	482,983	652,230
1984	940,830	149,145	102,641	689,044	891,282
1985	1,070,996	164,303	94,670	812,023	1,009,959
1986	834,05	212,578	169,984	451,497	539,436
1987**	301,410	86,153	90,654	124,603	142,597
Total	4,019,690	812,968	629,492	2,577,230	3,259,908

* July 1 - December 31, 1982
** January 1 - June 30, 1987

Total Graduates = 35
Total Graduates Employed by Health and Welfare Canada = 32

Average Cost per HWC employed Graduate = (actual) $ 80,538
(adjusted) $101,872

Delivery costs typically consist of the cost of reaching the target population and delivering the service (Austin, 1978). The cost of reaching the target population is ascribed to travel costs of the dental therapists. Since this is a cost that would have been incurred anyway in the form of visiting dental teams and patient transportation, it was not included in the delivery cost analysis (Austin, 1978). The cost of delivering the service consists of the cost of the portable dental clinics used by dental therapists and the variable costs of consumable supplies used by dental therapists in providing dental services. Since the cost of the portable dental clinic is included in the operations and maintenance budget of the National School of Dental Therapy, which was included in the training cost analysis, the cost of delivering the service was ascribed only to the variable costs of consumable supplies used by dental therapists in providing dental services.

Since there is an obvious association between employment costs and delivery costs, the two were calculated together. Table 18 displays the total annual employment costs and delivery costs, adjusted to 1990 dollar values, of the dental therapists in the study group from date of appointment to the date of termination or to June 30, 1990, which ever came first. The time line for these analyses was from 1984 through June 30, 1990.

As can be noted in Table 18, the combined employment costs and delivery costs increased between 1984 and 1988 and began to decline in 1989. Employment costs and delivery costs for 1990 were calculated for the six months only. Despite an overall attrition of 9 dental therapists by 1990, the salary figure for 1990 appears to be

Table 18
Employment Costs and Delivery Costs 1984-1990

	Employment Costs			Delivery Costs		
	Hiring	+ Salary	+ IPA*	+ Supplies	= Annual Total	= 1990 $ Value
1984	18,000	70,804	9,028	3,101	100,933	130,577
1985	30,000	269,727	34,172	29,090	362,989	451,470
1986	21,000	478,435	56,338	56,459	612,232	731,475
1987	24,000	729,031	88,943	71,235	913,209	1,045,091
1988	3,000	868,953	54,245	73,029	999,227	1,099,549
1989	------	822,743	50,428	71,486	944,657	990,001
1990**	------	442,635	24,231	38,939	505,805	505,805
Total	96,000	3,682,328	317,385	343,339	4,343,052	4,953,948

* IPA = Isolated Post Allowances
** January 1, - June 30, 1990

greater than the proportional amount in the two preceding years. This is directly attributable to annual increments in rates of pay to which all dental therapists are entitled.

Table 19 summarizes the data on the complete cost analysis to arrive at the total adjusted program cost. The relationship between the program benefits and costs adjusted to 1990 dollars is illustrated in Figure 18.

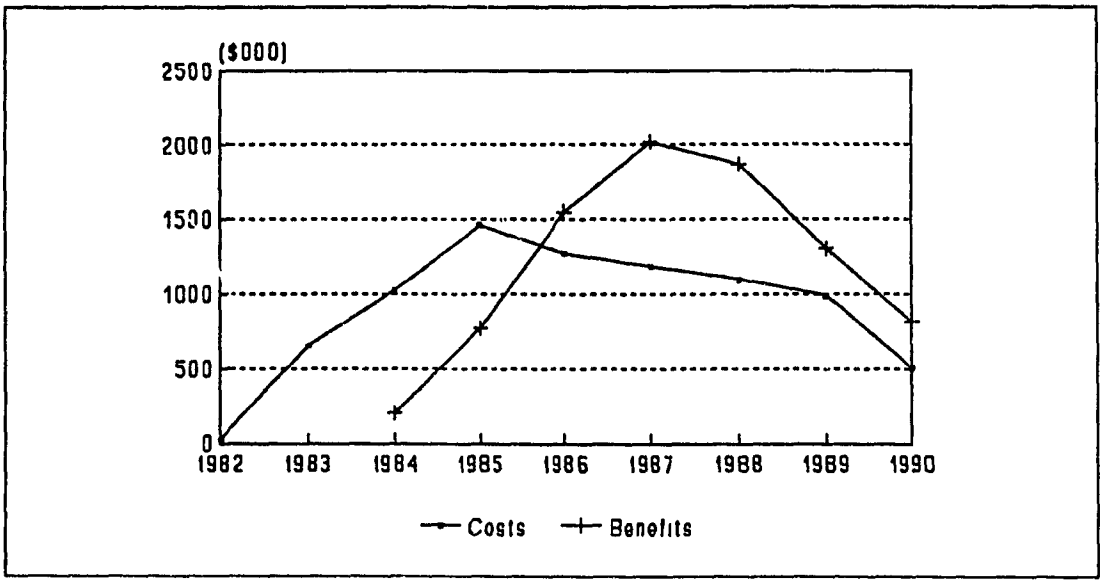
It can be seen that starting in 1986 the annual benefits accruing from the study group began to exceed annual program costs, which also included the annual training costs. This suggests that calculated on an annual basis, with as few as 25 dental therapists in place, the annual benefits accruing from the study group exceeded the annual operating costs of the study group, including the training costs. The benefits continued to increase through 1987 as 7 more dental therapists were added to the study group.

Table 19
Total Program Costs, 1982-1990

	Training Costs	+ Employment Costs	+ Delivery	= Annual Total	= 1990 $ Value
1982*	17,080	------	-----	17,080	24,404
1983	482,983	------	-----	482,983	652,230
1984	689,044	97,832	3,101	789,977	1,021,839
1985	812,023	333,899	29,090	1,175,012	1,461,429
1986	451,497	555,773	56,459	1,063,729	1,270,911
1987	124,603	841,974	71,235	1,037,812	1,187,688
1988	-------	926,198	73,029	999,227	1,099,549
1989	-------	873,171	71,486	944,657	990,001
1990**	-------	466,866	38,939	505,805	505,805
Total	2,577,230	4,095,713	343,339	7,016,282	8,213,896

* July 1, - December 31, 1982
** January 1, - June 30, 1990

Figure 18
The Relationship of Costs to Benefits over Time, 1982-1990



Following 1987, as dental therapists in the study group began to separate from the program, program benefits began to decline sharply while program costs exhibited only a gradual decline (the sharp decline in costs and benefits from 1989 to 1990 is an artifact of the study design since costs and benefits in 1990 were only calculated for the first six months). This suggests that program benefits are more sensitive to the loss of a dental therapist than program costs. This is directly attributable to annual increments in the rates of pay for all dental therapists. Between the fall of 1984 and the spring of 1990, the starting salary for a new graduate increased from $29,000 per annum to $44,092 per annum, or an augmentation of 52 percent. There was a proportional increase in the salaries of experienced dental therapists. During the same period of time, the average annual suggested fee for 1 RVU (here defined as a one-surface amalgam, primary tooth) for all provinces and territories employing dental therapists increased from $22.81 to $31.33, or 37 percent. This trend can be expected to further narrow the gap between program benefits and program costs. The simultaneous change in wages and further attrition of dental therapists will sharply narrow the gap between program benefits and program costs.

So far, only the annual benefits and costs have been compared. Figure 18 also illustrates that from 1982 through 1985 the study group functioned at a deficit due to the fact that training costs, employment costs and delivery costs lagged behind benefits. Since the deficit must be "paid off," some of the surplus benefits which began to accrue in 1986 will have to be used to pay down the deficit incurred from 1982 through 1985. The evaluative judgement of the economic efficiency of the study

group is therefore based on the absolute size of the gain of the program during the study period. The expectation is that over the life of the study period, the aggregated benefits of the study group will exceed the aggregated costs of training and employment. This comparison is achieved using the net present value approach.

Net Present Value

Until now all annual costs and benefits of the study group have been calculated for a single point in time, 1990, by adjusting for inflation. To decide if the investment has been worthwhile, the net present value approach to comparing benefits and costs is usually preferred by economists. The present value of costs and benefits of a project in any year are obtained by deflating dollar figures reported for all years to a price level of a single year (1982) and multiplying the cost or benefit in constant dollars by a discount factor. The discounted values of costs and benefits in all years are then summed to yield total present values of costs and benefits.

According to Warren and Luce (1982) once one has controlled for inflation, real discount rates tend to be quite small, from 1 to 4 percent. Table 20 displays the discounted benefits and costs of the study group at different discount rates to examine the study group's economic probability as a function of the discount rate.

The net present value or absolute gain of the study group is obtained by subtracting the present dollar value of program costs from the present dollar value of program benefits. The program is considered to be cost efficient if the net present value is greater than zero. Table 21 shows the net present value of the benefits and costs of

Table 20
Discounted Benefits and Costs

Year		Benefits Sum ($) at Discount Rates				Costs Sum ($) at Discount Rates			
		0%	2%	4%	6%	0%	2%	4%	6%
1982	0	0	0	0	0	17,080	17,080	17,080	17,080
1983	1	0	0	0	0	456,506	447,558	438,930	430,668
1984	2	141,697	136,199	131,013	126,110	715,201	687,451	661,275	636,529
1985	3	540,583	509,391	480,378	453,873	1,022,876	963,856	909,337	858,807
1986	4	1.082,750	1,000,244	925,535	857,646	889,530	821,748	760,370	704,577
1987	5	1,411,235	1,278,156	1,159,894	1,054,616	831,281	752,891	683,230	621,216
1988	6	1,305,038	1,158,874	1,031,372	920,052	769,591	683,397	608,208	542,562
1989	7	915,0764	797,264	695,889	609,075	692,916	603,253	526,547	460,858
1990	8	567,691	484,524	414,812	356,169	354,021	302,157	258,683	222,113
		5,965,758	5,364,652	4,839,093	4,377,541	5,749,391	5,279,391	4,863,660	4,494,520

the dental therapy program for each discount factor 0, 2, 4, and 6 percent. A second comparison of benefits and costs, the benefit-cost ratio (B/C) is also reported in Table 21. The benefit-cost ratio is obtained by dividing the net present value of benefits by the net present value of costs. It tells us how large the gain is relative to the size of the investment (Barsby, 1972). A benefit-cost ratio greater than 1 reveals there has been a net increase in the value of production; a value of 1 is considered break even.

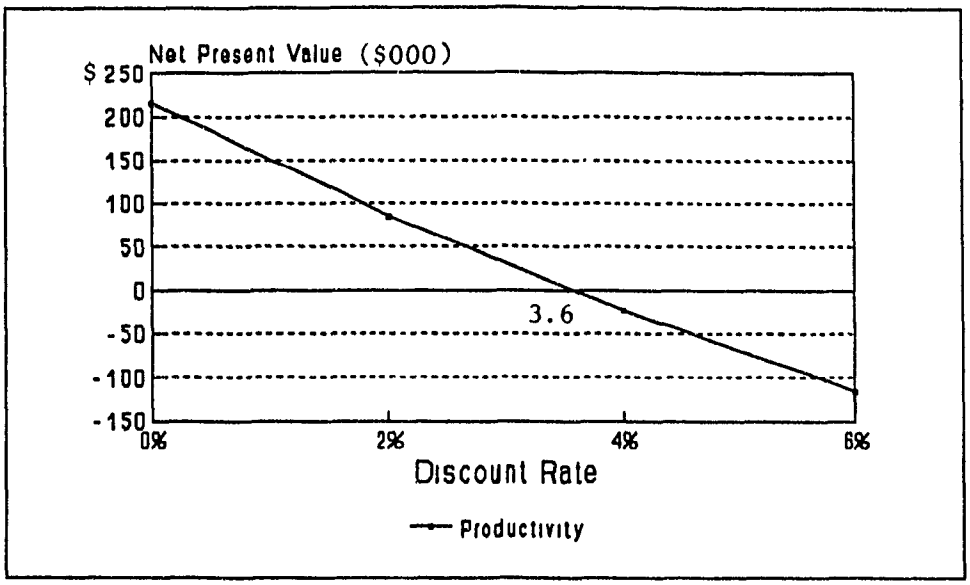
Table 21
Net Present Value of the Benefits and Costs of Training and Employing Dental Therapists at Selected Discount Rates

	PV Benefits	PV Costs	NPV	B/C
0%	5,964,758	5,749,002	215,756	1.04
2%	5,364,652	5,279,391	85,261	1.02
4%	4,839,093	4,863,660	-24,567	0.99
6%	4,377,541	4,494,520	-116,979	0.97

The relationship between the net present value of the study group and the social discount rates is illustrated in Figure 19 where the vertical axis measures the net present value and the horizontal axis measures the discount rate.

Figure 19 shows that for social discount rates below 3.6 (where the productivity line crosses the horizontal axis - also known as the internal rate of return), the present value of the study group's benefits exceeds the present value of the group's costs (the net present value of the study group is positive). There is no agreement in the literature over the choice of discount rate. Warner and Luce (1982) state that a

Figure 19
The Effect of Discount Rate Changes on the Magnitude of Net Present Value



reasonable discount rate for inflation controlled figures in health care programs is 3 percent. Accordingly, this suggests that, using the cohort of 32 dental therapists as a model of dental therapy program, the program makes good economic sense.

Many studies in the private sector use 7 percent, but Treasury Board of Canada suggests 10 percent. The 10 percent figure suggested by Treasury Board is the result of an inflationary mentality which is more suited to public projects such as the construction of airports, highways, and dams. It is an unduly large figure for health care programs (Warren & Luce, 1982). This bias is felt most keenly in health programs such as the dental therapy program where benefits in terms of improvements in the patient's dental health leads directly to lower consumption of dental services, and where the health benefits are deferred until well in the future.

It should be noted that the net present values reported in Table 21 represent a conservative estimate of the efficiency of the study group. No program benefits, other than the dollar value of intraoral work done by the dental therapists, were considered in deriving the net present value, and the cost of training was overestimated in ways discussed above. More importantly, the benefits were calculated entirely using fees published in provincial dental fee guides and subsequently do not take into account the sums in excess of that amount reflecting the additional expenditures for contract dentists who, in fact, provide the bulk of dental services.

The size of the absolute gain of the study group does not imply the size of the absolute gain of the dental therapy program. The absolute gain of the study group was based on the economic analysis of 32 dental therapists with an average of 4 years experience. It should be recalled that over 59 percent (N=37) of the current workforce of dental therapists have over 5 years experience (see Table 13). The inference, therefore, is that all things being equal, the absolute gain of the dental therapy program is proportionally more than that of the study group.

If the dental therapy program is an attempt by the Federal Government to, among other things, increase dental care coverage and equity to those for whose care it is charged, and who were previously under-served by the private sector, it would be misleading to evaluate the benefits of the program simply by using the prices charged by private dental practitioners. According to Blaug,

> In almost all cases in which the output of the public sector can be evaluated by means of prices of comparable private activity, the prices are not quite the weight we are looking for (Blaug, 1970, p. 121).

Although the benefits are weighted in dollar terms from the private sector in order to satisfy the economic objective, they do not take into account the social desirability of the program which encompasses the political and ethical objectives of providing services to under-served areas. When a program of dental care is being delivered to rural, under-served, and economically disadvantaged groups, can it really be measured with the same meter as that provided to better-off urban communities (Mills, 1985a)? The presence of dental therapists in these communities, hence the access to dental care, is worth more to the Federal Government than dollars and cents charged in the private sector. Therefore, the present study does not reflect appropriate consideration for equity and distributive justice (Drummond, Stoddart, & Torrance, 1987; Warren & Luce, 1982). Subsequently, the use of shadow prices to adjust the value of the benefits to take into account the distortion created by the use of mere market prices and government objectives would enhance the net present value of the dental therapy program.

Another methodological issue relates to the preferred approach of directly comparing the cost of dental programs in communities served by dental therapists with the cost of dental programs in communities served entirely by dentists working on a contractual basis. Data for this approach would have to come from two major sources: management information on the dental program and field surveys. An earlier assessment study revealed serious inadequacies in the amount and quality of management information about dentists working on a contractual basis. Some of these inadequacies rendered it virtually impossible to compare dental therapists with contract dentists

without incurring considerable time and expense. A key question to be answered in such a study would deal with the nature of services provided by each type of personnel. Case studies in the Yukon and Northwest Territories have revealed that when patterns of treatment between itinerate dentists and local resident dental therapists are compared, the dentists see more patients but perform fewer treatments per patient and are more often prone to extract teeth; whereas the dental therapist tries to complete all the necessary work for the patient and places a strong emphasis on restorative care (HWC, 1987). This provides a solid line of evidence of the continuity and comprehensiveness of services provided by dental therapists which may not be available through the use of itinerate dentists. This issue will be examined in the "Quality of Care" section of the present study. Lastly, such a controlled study would require that communities be selected and matched on a number of important variables.

It is unquestionably rather intimidating to reduce a large and highly organized program such as the dental therapy program into a single figure which is generally viewed by many researchers as being inadequate in and of itself in rendering an evaluative judgement (Anthony & Young, 1985b; Ray, 1984; Reddy, 1979; White et al., 1983). The net present value figure provides information only on the economic aspect of one narrow component of the program. It does not entirely satisfy the basic question guiding this study: Are the resources consumed by the program commensurate with the results obtained? The obtained program results should be much larger than the economic value of intraoral work performed by individual dental therapists on individual clients.

Quality of Care

The economic analysis should not be expected to provide the entire answer to the merit and worth of the dental therapy program. The benefits of the program are more than the economic spin-offs of individual clinical services. Benefits are also those favourable effects resulting from the delivery of the program (Mills and Thomas, 1984).

The favourable outcome of the economic analysis could be misleading since the reported net present value provides no information on the level and quality of care provided by dental therapists. Acceptable levels of care are important to ensure that effort is not lost by dental therapists in providing services repetitively and inappropriately resulting in possibly inflated productivity figures, on which the economic analysis was based, leading to a false positive outcome of the economic analysis. Moreover, the economic value of dental therapists' output was determined by using the fees chargeable by dental practitioners for performing the same service. This carries an implicit assumption that treatment services provided by dental therapists have the same clinical effects as treatment services carried out by dental practitioners. If they do not have the same clinical effects, it would have been erroneous to use dental fees chargeable by private dental practitioners to determine the economic value of dental therapists' services.

The calculated net present value of the dental therapy program was quite sensitive to treatment services provided by dental therapists, but insensitive to the broad health objectives which lie behind primary health care in general and the related health

impacts and effects dental therapists have had on the communities they serve. The following two sections address the quality of clinical care and the quality of community care provided by dental therapists.

Quality of Clinical Care

A detailed examination of the quality of dental restorations placed by dentists and dental therapists in five Baffin communities was carried out by Dr. P.Ralph Crawford and Dr. Bradley Holmes (1989). The objective of the study was to assess and evaluate dental treatment provided to the Inuit people living on Baffin Island. Evaluations were obtained for 983 restorations placed by dental therapists and 877 restorations placed by dentists. All restorations had been placed within the preceding 18 months. Restorations were classified as "superior", "satisfactory", or "failed".

The final report submitted by the researchers was in the form of frequency counts and percentages of the three classifications of various dental restoration procedures by service provider in each of the five communities involved in the study. Appendix I summarizes the findings of the study. One limitation of the study was the failure to make maximum use of the data collected. Therefore, the statistical analysis of these data is under-represented. The following applications of additional statistical techniques serve to more accurately communicate the nature of the findings and how seriously to regard the apparent differences found between dental therapists and dentists. Table 22 summarizes the overall findings of the study.

Table 22
Reported Frequencies and Percentages for Quality Ratings of Dental Restorations by Dentists and Dental Therapists

	Dentists		Dental Therapists	
Quality	N	%	N	%
Superior	71	8	312	32
Satisfactory	706	81	646	65
Failed	100	11	25	3
Total	877	100.00	983	100.00

$\chi^2 = 199.24$, $p < 0.0001$, $df = 2$

Theoretically, one should not expect a difference in the frequency of ratings assigned to dentists and those assigned to dental therapists. The subsequent null hypothesis is that the quality of dental restorations is not related to the provider. To measure the discrepancy between observed and expected frequencies, a chi-square test of independence was computed.

A 2 x 3 independent samples chi-square analysis of Table 22 revealed $\chi^2 = 199.24$, $p < 0.0001$, $df = 2$. The sample χ^2 clearly falls beyond the critical value, and the null hypothesis of independence is rejected. It is concluded that the quality of dental restorations is dependent upon the provider.

A similar chi-square analysis of the null hypothesis was carried out by collapsing the "superior" and "satisfactory" categories of quality for both providers (Table 21) into one category labelled "acceptable" to form two variables: "acceptable" and "failed". A 2 x 2 independent samples chi-square analysis revealed $\chi^2 = 47.31$, $p <$

0.0001, $df = 1$. The data supports the rejection of the null hypothesis, and once again it is concluded that there is a relationship between the provider and the level of care.

The above chi-square tests are based on overall ratings for all types of dental restorations. They do not identify which of the eight types of restorations are responsible for the overall chi-square (Keppel & Saufley, 1980). Analytical comparisons that will identify specific differences between types of restorations by provider require an arithmetic mean and standard deviation. To obtain these two measures, a weighted index was used in which ratings of "superior", "satisfactory", and "failed" were assigned values of 3, 2, and 1, respectively. Multiplying the frequency of each rating by the appropriate value provided an overall score for the rating of 6 of the 8 types of restoration by service provider. Accordingly, the *t*-test of independent samples was used to test the statistical significance of the differences between dental therapists and dentists for each type of restoration. The results are reported in Table 23.

Table 23
Means, Standard Deviations, and *t*-Test Results for Dental Restorations

Restoration	Dental Therapists		Dentists		
	Mean	SD	Mean	SD	*t*
One-surface amalgam	2.28	.47	2.03	.36	8.06*
Two-surface amalgam	2.37	.51	1.98	.45	8.30*
Three-surface amalgam	2.52	.50	1.97	.45	7.33*
Four-surface amalgam	2.57	.51	2.15	.49	2.41**
Composite one-surface	1.85	.46	1.85	.48	----
Composite two-surface	2.06	.57	1.93	.47	.93

*$p < 0.001$; **$p < 0.03$

Table 23 shows the mean quality standards achieved by both dental therapists and dentists for six clinical procedures. The test of significance indicates a clear difference in favour of the dental therapists for all amalgam restorations. In a similar study in Saskatchewan in 1976, Ambrose, Hord, and Simpson (1976) assessed the quality of the most common restorative treatment services being carried out by dental nurses and dentists. A total of 2,107 amalgam restorations were rated on a scale from 1 to 3 by the examiners. The *t*-tests demonstrated a significant difference for each amalgam restoration at the .001 level. This reveals a similarity of findings with regard to one- two- and three-surface restorations in the above study. In the Saskatchewan study, the values for two- three- and four-amalgams were combined into one variable labelled "multisurface fillings". In the present study, when two- three- and four surface amalgams were combined and analyzed as one variable, parallel results were obtained ($t = 7.85$; $p < .001$).

The *t*-test of significance for one- and two-surface composite restorations did not approach critical value, indicating that dental therapists and dentists appear to function at the same standard of quality. This finding is as one might expect, given the greater task complexity of composite restorations over amalgam restorations. Statistical analysis was not carried out on composite three surface restorations due to the smallness of the sample size and on stainless steel crowns due to the sample size and obvious violation of the assumption that the two populations are normally distributed (see Appendix I).

From a statistical point of view, on the basis of six clinical restorative procedures

encompassing 1799 dental restorations, the quality of restorations placed by dental therapists was equal to but more often better than that of those placed by dentists. The significance of these findings is further elaborated by Gruebbel (cited in De Jong & Dunning, 1970) who utilized the adequacy of dental restorations as an index to the overall quality of dental treatment. Other researchers have also used the quality of dental restorations as an index to overall quality of care. Bagramian, Jenny, Woodbury, and Proshek (1975) studied the quality of dental restorations in a large population of school children (N=838). These researchers detected a significant problem of low quality dental restorations which was found to be unrelated to the socioeconomic status of the parent. Indications of high quality dentistry were illustrated by stainless steel crowns, space maintainers, and orthodontic appliances in association with good quality amalgam restorations. According to these authors,

> It is possible...to suggest that the quality of restorative service could reflect or measure the total quality of care being provided to the patient. And certainly the first step in assessing quality is the restoration. If all other levels are adequate but the restoration is unacceptable the service has failed. This is not true in the opposite direction (Bagramian, Jenny, Woodbury, & Proshek, 1975, p. 398).

The significance of these findings also has direct implications for the economic analysis of the program. A gain in quality of care also represents an equivalent gain in resources (Abramowitz & Mecklenburg, 1972). The dentists in the Crawford/ Holmes study had an overall failure rate of 11.4 percent, while the overall failure rate for dental therapists was only 2.5 percent (see Appendix I). The difference between the two is 8.9 percent or a 9 percent gain in resources directly attributable to the dental therapy program (Abramowitz & Mecklenburg, 1972).

An important question arising from the very favourable findings in the quality of restorations placed by dental therapists in the study group relates directly to the external validity of the findings: To what extent can these findings be generalized to other dental therapists trained by Health and Welfare Canada and employed in other Indian and northern communities? According to Borg and Gall (1983), the carryover of research findings from the experimentally accessible population to the target population can be described by comparing the two populations to determine if they are similar in critical respects. The similarity of the experimentally accessible dental therapists and the target population dental therapists can be described in terms of the extensive standardization of the dental therapy program; the availability of supplies, equipment and instruments to all dental therapists; and the reported effects of continuing education.

Program Standardization

In the performance of his/her clinical duties, the dental therapist generally carries out all assigned duties and tasks without a dentist present. To counteract the lack of direct supervision, the dental therapy program has been carefully and elaborately standardized in virtually every detail. This high degree of standardization is maintained throughout the system including all aspects of training. As a matter of policy dental therapists are carefully trained to only perform specified dental procedures in a specific way. They are trained to the use of one set of source materials and manuals developed explicitly for the program. The standardization pattern includes uniform equipment, instruments, and supplies throughout the system. Subsequently, dental

therapists are able to transfer anywhere within the system and become fully operational immediately.

The high degree of standardization in the training of dental therapists and the operation of the program plus its high degree of enforcement, provide a reliable line of evidence of the similarity of all dental therapists in critical respects. Therefore, it may be assumed that the quality of care found in this study is, in general, descriptive of the quality of care provided by the target population of dental therapists.

Availability of Supplies, Instruments and Equipment

In a 1986 report to the World Bank by Berman et al., one of the factors identified as affecting the quality of care provided by auxiliary health personnel was the availability of appropriate supplies, instruments, and equipment. This essential requirement was reported as being a factor of the logistics and support systems backing up the auxiliary health worker.

One would normally expect dental therapists to have available all of the appropriate instruments, supplies and equipment with which to carry out their daily tasks. Since the majority of dental therapists live and work in rural communities and isolated settlements, and since the communities in the quality of care study are isolated communities, one might speculate that the logistics and support systems ensure that they are particularly well provisioned to carry out their tasks.

Do all dental therapists have the required supplies and equipment to adequately perform their duties as trained? To answer this question, dental therapists were asked to describe their present situation. Respondents stated whether they "never" have,

"seldom" have, "almost always" have, or "always" have the appropriate instruments, supplies, and equipment needed to do the job. Table 24 tabulates the data by geographical location of the dental therapist.

Employing nonparametric procedures through SPSS CROSSTABS, no significant difference was found among the groups in this measure. A chi-square of 1.02 indicates that dental therapists living in rural, urban, and remote locations do not respond differently concerning the availability of instruments, supplies, and equipment. By combining the totals of columns (3) and (4), it can be said that 97% of all dental therapists report having the required supplies and equipment with which to perform their daily tasks. It may be assumed that all dental therapists working in Indian and

Table 24
Availability of Instruments, Supplies, and Equipment by Geographical Location of the Dental Therapist.

	Never (1)		Seldom (2)		Almost Always (3)		Always (4)		Total	
	N	%	N	%	N	%	N	%	N	%
Urban	0	0	1	4	9	41	12	55	22	100
Rural	0	0	0	0	6	35	11	65	17	100%
Remote	0	0	1	4	9	39	13	57	23	100%
Totals	0%		2	3%	24	39%	36	58%	62	100%

$\chi^2=1.02,\ p > .91,\ df = 4$

northern communities in Canada are as well provisioned as those in the study group. Furthermore, it would appear that the dental therapy program has not suffered

significant cut-offs of supplies, instruments and equipment as a result of recent cuts in government spending.

Continuing education

Continuing education is thought by many to maintain and improve quality of care of health workers (Abbatt & Mejia, 1988; Fisher, 1971; Soricelli, 1971; Turner, 1986; Young, 1983). Abbatt and Mejia (1988) define continuing education of health workers as,

> all the experiences, after initial training, that help health care personnel to maintain or learn competencies relevant to the provision of health care. (Abbatt & Mejia, 1988, p. 9).

This implies that continuing education may have had an important role in strengthening and extending the quality of care provided by dental therapists in the study group. If the benefits of continuing education are unevenly distributed in the population of dental therapists, this may pose a threat to the external validity of the findings.

In order to determine the perceived benefits of continuing education, dental therapists were asked if they had participated in any form of continuing education within the preceding 24 months. From a total of 62 respondents, 6 dental therapists or 10 percent, reported not having participated in any form of continuing education activity within the preceding 24 months. Non-participation does not pose a threat to the external validity of this study. This group was not analyzed any further.

The remaining respondents were provided three phrases which might describe the benefits of continuing education: "improved my job motivation," "improved my job performance", and "helped me to acquire new job skills". Each phrase was rated on a

scale from 1 to 4 as "no benefit - 1," "small benefit - 2," "moderate benefit" - 3, and "large benefit - 4."

The means and standard deviations for the three perceived benefits of continuing education are reported in Table 25. None of the mean scores of the benefit statements reached more than a "moderate benefit". Although all of the identified benefits of continuing education may be expected to have some effect on quality of care, the one which would be expected to have the most significant influence on the outcome of the quality of care assessment is the acquisition of new skills. Dental therapists rated the acquisition of new skills the lowest of the benefits of continuing education. Given the extent of indirect supervision of dental therapists with the resulting necessary high degree of standardization in the program, this response is considered favourable. Continuing education would understandably attempt to keep dental therapists "out of trouble" by not introducing subject matter which may encourage them to have expanded interests in other areas or techniques which might negatively influence the quality of the program.

Table 25
Means and Standard Deviations of the Perceived Benefits of Continuing Education

Benefit	Mean Score	SD
Improve Job Motivation	3.056	.89
Improve Job Performance	2.963	.87
Acquire New Skills	2.793	.91

It was not possible to directly compare the perceived benefits of continuing education of the quality of care study group with the perceived benefits of continuing education of the remainder of dental therapists. This was counterbalanced by comparing the benefits of continuing education by administrative regions in order to accommodate possible regional variations in the quantity and quality of continuing education activities.

Employing comparison of means procedure through SPSS ONEWAY, three separate analyses were conducted, one for each benefit statement. The null hypothesis that there is no difference in the perceptions of dental therapists in the different regions regarding the job motivation benefit of continuing education could not be rejected at α .05 level [$F(6,45) = 1.48$, $p > .21$]. The statistical data are reported in Table 26. The null hypothesis that there is no difference in the perceptions of dental therapists in the different regions regarding the job performance benefit of continuing education, could not be rejected at $\alpha = .05$ level [$F(6,46) = 1.51$, $p > .19$]. The statistical data are reported in Table 27. The null hypothesis that there is no difference in the perceptions of dental therapists in the different regions regarding the acquisition of new job skills benefit of continuing education could not be rejected at $\alpha = .05$ level [$F(6,45) = 0.28$, $p > .94$]. The statistical data are presented in Table 28.

The content of continuing education is variable. A possible limitation of this analysis is that the benefits of continuing education are measured without any information on course offerings. This is alleviated to a great extent by the fact that the major continuing education event for most dental therapists is the Dental Therapists'

Table 26
Analysis of Variance for the Job Motivation Benefit of Continuing Education by Region

	Sum of Sqs	df	Mean Sq.	*F*	*Prob.*
Between Groups	6.5471	6	1.0915	1.4820	.2060
Within Groups	33.1433	45	.73		
Total	39.6923	51			

Table 27
Analysis of Variance for the Job Performance Benefit of Continuing Education by Region

	Sum of Sqs	df	Mean Sq.	*F*	*Prob.*
Between Groups	6.4311	6	1.0719	1.5148	.1946
Within Groups	32.5510	46	.7074		
Total	38.9811	52			

Table 28
Analysis of Variance for the Acquisition of New Job Skills Benefit of Continuing Education by Region

	Sum of Sqs	df	Mean Sq.	*F*	*Prob.*
Between Groups	1.5584	6	.2597	.2843	.9414
Within Groups	41.1147	45	.9137		
Total	42.6731	51			

Refresher Course provided every second year by the National School of Dental Therapy. Therefore, it is assumed that the ratings of dental therapists were greatly guided by the same continuing education offerings.

It is concluded that there is no difference among dental therapists on the reported benefits of continuing education. Continuing education does not pose a threat to the external validity of the findings of the quality of care assessment.

The statistical analyses in this section have established that the quality of restorations placed by dental therapists in the experimentally accessible population were equal to if not better than those placed by dentists. The findings in the experimentally accessible population of dental therapists appear to be generalizable to the target population on the basis of their similarity in skill sets and standardization of the program, on the basis of availability of supplies, instruments and equipment to perform their duties, and on the basis of the effects of continuing education. Clinical treatment services provided by dental therapists have the same treatment effect as clinical services provided by dentists. It was not erroneous to use dental fees chargeable by private dental practitioners to determine the economic value of dental therapists' work.

There are three possible interdependent confounding variables associated with the differential effects found in the quality of clinical care. First, dental therapists in training spend almost four times as much time on the subject of restorative dentistry than undergraduate dental students (Petrikowski, 1988). Second, an important component of the quality control system built into the dental therapy program is periodic evaluation by dentists of the quality of selected procedures performed by dental

therapists. Accordingly, unlike dentists, dental therapists carry out dental procedures aware that the end-results are subject to future assessment by a dentist. Third, Roder (1978) suggests that a confounding variable associated with the differential effects are those related to salaried (dental therapists) and fee-for-service (dentists) system. The suggestion is that dental therapists are salaried and will suffer no loss in revenue by taking their time; whereas dentists are "piece work" operators whose economic gain is linked directly to output levels.

The above variables offer yet additional evidence of the overall merit of the dental therapy program. Student dental therapists spend more classroom/clinical time studying restorative dentistry than undergraduate dental students and periodic assessment of the quality of clinical services provided by dental therapists provides assurance to the consumer, to the dental profession, and to dental therapists themselves that the dental therapy program is not a "second rate" delivery system. It also serves to rule out possible criticism that training and supervision are lax or overly lenient. This aspect of quality assurance has resulted in dental therapists out performing dentists on several types of restorative procedures. There is a strong suggestion here that all dental services now being delivered to Medical Services Branch clientele are not quality. This raises the question if, as a matter of quality safeguard, the care provided by dentists working in a third party payment system, should not be similarly evaluated to ensure that the care provided is appropriate and technically sound.

Quality of Community Care

In the preceding section the quality of restorative dental care provided by dental therapists and dentists was evaluated. The statistical conclusion was that restorations placed by dental therapists were on the average better than those placed by dentists. Although such end-results provide important information on the quality of dental services provided to individuals, it does not tell us if the dental therapy program is having any effect in the community. Improvement in the community's dental health status should be the minimum requirement in determining if the resources consumed by the dental therapy program are commensurate with the results obtained. Mills and Thomas state,

> ...to the epidemiologists, economists, politicians, planners, and most of all people themselves, it is the knowledge of the ultimate effectiveness of interventions which is of greatest interest. (Mills & Thomas, 1984, pp. 15-16).

In the absence of direct measures on health impact, it is standard procedure to use measures of intermediate output (Abel-Smith, cited in Mills & Thomas, 1984) such as number of restorations and extractions. A general index of the degree to which dental health has improved in the communities served by dental therapists is the *ratio of restorations to extractions.* This index is highly sensitive to the commitment of dental therapists to render comprehensive care (Dunning, 1986). The results have also been shown to correlate excellently with the quality of services provided to patients (De Jong & Dunning, 1970; DeLiefde & Ritchie, 1984). The ratio is calculated by dividing the total number of restorations placed in a given year with the total number

of extractions.

The ratio of restorations to extractions (R/E) by dental therapists was calculated by geographical region for the years 1978-1988 (Appendix R). A low R/E ratio is suggestive of poorer overall dental health in communities served by dental therapists within a region; while a higher ratio indicates better dental health among the population served. Some fluctuation in the R/E ratio between years within regions is also evident. This generally results from the expansion of the dental therapy program into previously unserved communities.

There are noticeable differences between Regions. The relatively low R/E ratios for Manitoba are suggestive of poorer dental health. The markedly higher ratio for Yukon indicates better dental health among the population served. The favoured position of the Yukon is explained by the fact that even before the dental therapy program was formally established in the Region, New Zealand trained dental nurses were already employed in the dental health program to provide dental health care to school children. Given the longer history of involvement in the dental therapy concept by the Yukon, their higher ratios may be predictive of future patterns in the other regions.

To test this assumption, a secular trend analysis was employed. An historical examination was made of the ratio of restorations to extractions performed by all dental therapists in Alberta Region, Atlantic Region, Manitoba Region, Saskatchewan Region and the Northwest Territories between the years 1978 and 1988 (Table 29). Pacific Region and Yukon Region were excluded from the examination since both

regions reveal consistently higher ratios than other regions for each year. These extremely large fluctuations would bias the trend pattern.

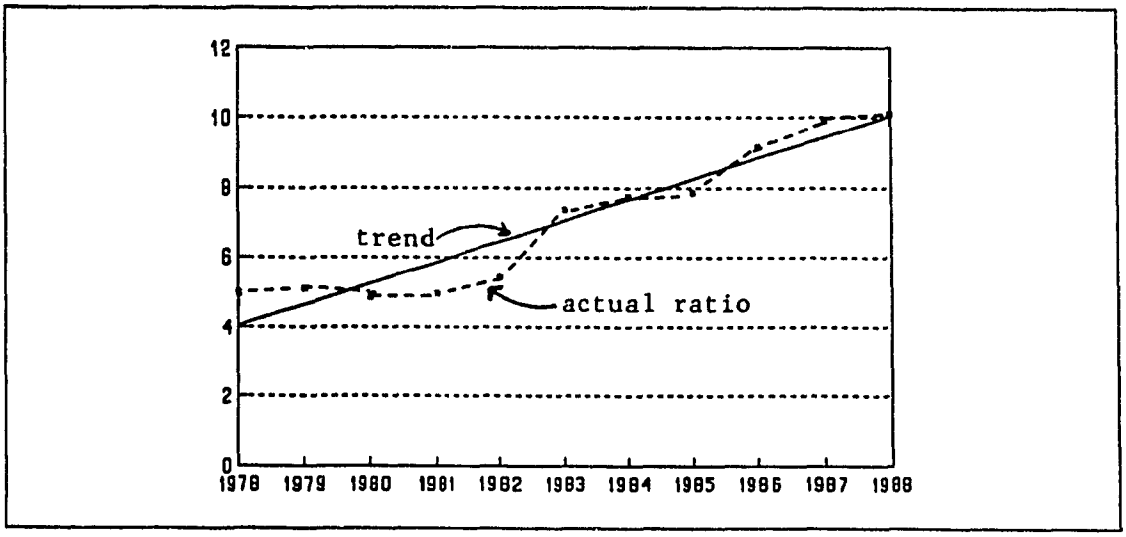
Table 29
Ratio of Restorations to Extractions by Dental Therapists, 1978-1988

	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988
R/E Ratio	4.97	5.10	4.83	4.95	5.42	7.33	7.74	7.86	9.15	9.92	10.16

Source: Annual Productivity Summaries, 1978-1988.

The data in Table 29 clearly shows a steadily increasing ratio which reveals dental therapists are having increasingly better effects on dental health in the communities they serve. The data plotted on an arithmetic scale (Fig. 20) shows basically an upward moving straight line. The least squares method was used to establish the "best-fitting" trend line. The slope of the trend line indicates a positive linear relationship of the R/E ratio to time. This steadily increasing trend is the result of fewer extractions over time relative to restorations which suggests that dental therapists are being successful in treating dental emergencies and in reducing them through regular on-going care. The steadily increasing trend is the first important line of evidence of the overall effectiveness of the dental therapists in improving dental health in the communities in which they work.

Figure 20
Ratio of Restorations to Extractions by Dental Therapists, 1978-1988, with Least Squares Straight Trend Line



A second ratio was calculated for the dental therapists from 1978 to 1988. This is the *ratio of restorative to preventive work.* This ratio is an important measure from the view point of public health dentistry and economics. The ratio is affected by the natural shift from restorations to more preventive work, and thus correlates quite nicely with improvements in dental health in the communities served by dental therapists. The ratio is derived by dividing the total restoration RVUs by the total preventive dentistry RVUs.

The ratio of restorative to preventive work was calculated by geographical region for all dental therapists from 1978-1988 (Appendix R). This ratio should decrease over time to show the desired shift from restorative services to preventive work. A low ratio indicates more preventive work than restorative work, suggesting overall improvements in the dental health of communities served by dental therapists.

To examine the trend over time, an historical examination was made of the ratio of restorative to preventive (R/P) work performed by all dental therapists in all regions, except the Yukon, for the years 1980 through 1988 (Table 30). The Yukon was excluded from the examination since the region reveals consistently lower (thus, favourable) R/P ratios than the other regions for each year which would bias the trend pattern. Also, years 1978 and 1979 were not included in the historical examination due to the extremely large ratios for Pacific Region (1978) and Manitoba Region (1979) which are not consistent with the ratios for the succeeding years for both regions.

The data in Table 30 reveals a steadily declining ratio indicative of consistently improving levels of dental health in the communities served by dental therapists. The data plotted on an arithmetic scale (Fig. 21) reveals a basically downward moving straight line. The least squares method was used to establish the "best-fitting" trend

Table 30
Ratio of Restorations to Preventive Work by Dental Therapists, 1980-1988

	1980	1981	1982	1983	1984	1985	1986	1987	1988
R/P Ratio	3.30	3.10	2.90	2.27	1.82	1.29	.99	.97	.91

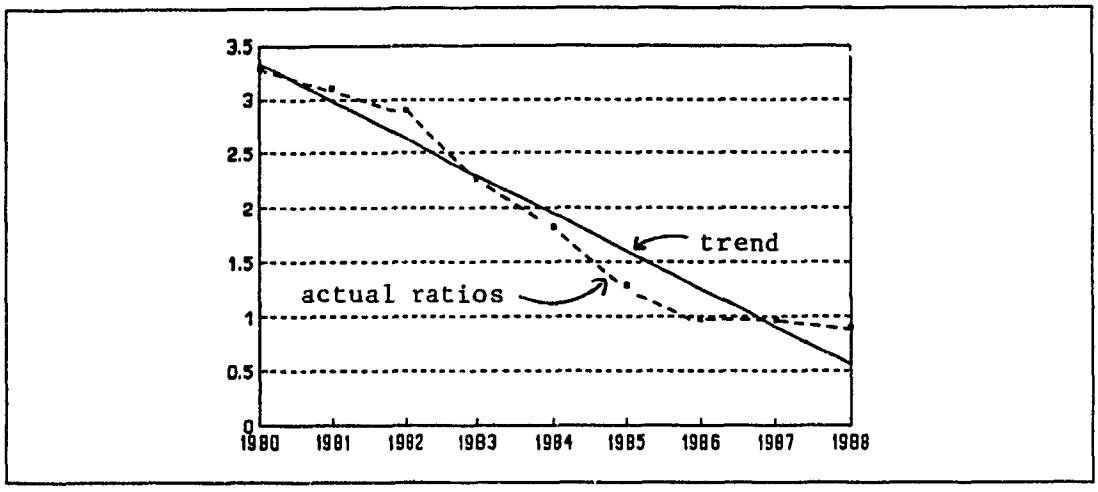
Source: Annual Productivity Summaries

line. The slope of the trend line indicates a negative relationship of R/P ratio to time. The trend is the result of a steady decrease in restorations in favour of more preventive work. The actual ratio line displays a levelling off effect after 1986. This indicates that dental therapists are being successful in bringing communities to maintenance level. The steadily decreasing trend is clearly in the direction of encouraging prevention and promoting positive outcomes and is the second important line of evidence of the overall effectiveness of the dental therapists in improving dental health in the communities in which they work.

This steadily declining ratio, indicative of improving levels of dental health, also points to additional savings to Health and Welfare Canada in the form of reduction in future treatment costs and costs directly associated with treatment (e.g., transportation). This is one of the main arguments for preventive measures (Mills, 1985a; Drummond & Stoddart, 1985). This also helps to explain the low Net Present Value found earlier in this study. The net present value resulted when the computed benefits of the program were linked almost entirely to clinical dentistry. According to the R/P ratio, the need for clinical dentistry may be decreasing in communities served by dental therapists. Therefore, the dental therapy program may be justified on the grounds of savings in future treatment expenditures alone.

If the dental therapy program is being effective in improving the dental health of the communities in which dental therapists work, over time one would expect to find in these communities a consistent relationship between the ratio of restorations to extractions and the ratio of restorations to preventive work. To examine the extent to

Figure 21
Ratio of Restorations to Preventive Work by Dental Therapists, 1980-1988 with Least Squares Trend Line



which a relationship exists between the two variables, the ratios were calculated for the common elements (Regions and years) in Tables 29 and 30. The hypothesis driving the analysis was that there is no relationship between the ratio of restorations to extractions and the ratio of restorations to preventive work in the communities where dental therapists are employed. Table 31 shows the results.

Employing SPSS procedure CROSSTAB, subprogram CORR produces Pearson's Product-Moment Correlation with significance levels. Its value was found to be -.94, which indicates that there is a very strong negative correlation between the two ratios. Although the strong relationship between the two ratios does not provide evidence of a cause-and-effect relationship, the presence of the correlation makes such a relationship more plausible. Indeed, the absence of a correlation would be used to rule out a cause-and-effect relationship.

Table 31
Relationship between the Ratio of Restorations to Extractions and the Ratio of Restorations to Preventive Work in Dental Therapist Communities, 1981-1988

Year	R/E	R/P
1981	4.95	2.82
1982	5.86	2.68
1983	7.33	2.28
1984	7.74	1.77
1985	7.86	1.27
1986	9.15	1.00
1987	9.92	.99
1988	10.28	.93

Pearson's $r = -.94$, $p < .00033$.

Précis

The quality of clinical care and the quality of community care provided by dental therapists have been investigated. Dental therapists provide a very high quality of clinical care and community care resulting in positive outcomes for both the patient and the community. These results also have direct positive outcomes for Health and Welfare Canada. The quality of care findings coupled with the findings from the economic analysis of the dental therapy program reveal that dental therapists are a good pool of health manpower who can treat patients with high quality of care at low cost. Considered in the light of the spiralling cost of health care, this has to be a government's dream come true.

Predisposition and Sentiments of Dental Therapists toward Their Job

The link between attitude and performance is an important issue in human resources development. In addition to knowing the quality of care and economic efficiency of dental therapists, there are reasons for wanting to know about their reactions to the work experience. The attitude of employees toward their job has a direct bearing on the quality of work performed and the economy efficiency by which it is carried out. Also, according to Parnes (1984), information of this kind serves two useful purposes. First, employee attitudes and sentiments toward the job provide a basis for predicting actual behaviour. Second, knowing the employee's reaction to the work experience indicates the extent to which that experience contributes to the aspirations and the self-fulfillment of the individual.

There are many different factors which can motivate individuals to pursue a certain career. It might be salary, prestige, location of the job, or the excitement of travel. Whatever the motivating factors, if the work experience does not succeed in realizing these factors, discontent with all of its manifestations can be expected. Employee dissatisfaction affects employee productivity which in turn reduces the efficiency of the organization.

Are the motivational factors which seem important to dental therapists in choosing a career in dental therapy being satisfied by the subsequent job experience? To answer this question dental therapists were asked to rate the importance, on a Likert-type scale, of a list of factors considered important in making a career choice. For

each factor dental therapists were asked to state whether it was "not important = 1", "little importance = 2," "moderately important = 3," or "very important = 4".

Table 32
Respondents' Rating of the Importance of Various Motivation Factors in Selecting a Career in Dental Therapy

	Not Important	Little Importance	Moderate Importance	Very Important	N =	Mean Score
Doing a Socially "useful" job	2 (3.3%)	3 (4.9%)	18 (29.5%)	38 (62.3%)	61 (100%)	3.51
High level of Responsibility	0 (0.0%)	5 (8.2%)	26 (42.6%)	30 (49.2%)	61 (100%)	3.41
Job Security	1 (1.6%)	4 (6.6%)	26 (42.6%)	30 (49.2%)	61 (100%)	3.39
Good Career Opportunity	1 (1.6%)	9 (14.8%)	21 (34.4%)	30 (49.2%)	61 (100%)	3.31
Variety in work	2 (3.3%)	6 (9.8%)	26 (42.6%)	27 (44.3%)	61 (100%)	3.28
Salary level	1 (1.6%)	5 (8.1%)	35 (56.5%)	21 (33.9%)	62 (100%)	3.23
Pleasant working conditions	1 (1.6%)	7 (11.5%)	36 (59.0%)	17 (21.9%)	61 (100%)	3.13
Geographical location of jobs	8 (12.9%)	19 (30.6%)	23 (37.1%)	12 (19.4%)	62 (100%)	2.63

NOTE: Percentages may not add to 100 due to rounding.

Table 32 sets forth the perceived importance of listed factors. The profile that emerges from these responses deserves some interpretation. The two factors which had the highest ratings are "doing a socially useful job" and "high level of responsibility". This response relative to "salary level", "pleasant working conditions", and "geographical location of jobs", which rank 6, 7 and 8, respectively, out of 8 factors,

suggests that dental therapists have a primary orientation to community rather than self-interest, and are motivated by jobs which contribute to the overall public good. These characteristic traits are consistent with current models of a profession (Brown, Knight, Patel, & Pilant, 1987).

Respondents were again asked to rate on a Likert-type scale the extent to which their expectations of the same factors were met by the subsequent job experience. For each factor dental therapists stated whether it was "worse than expected = 1", "same as expected = 2" or "better than expected = 3". The results are reported in Table 33.

Table 33
Respondents' Rating of Job Experience Relative to Expectations

	Worse than Expected	Same as Expected	Better than Expected	N =	Mean Score
Salary level	5 (8.1%)	27 (43.5%)	30 (48.4%)	62 (100%)	2.40
Doing a socially useful job	2 (3.2%)	37 (59.7%)	23 (37.1%)	62 (100%)	2.34
High level of responsibility	2 (3.3%)	37 (60.7%)	22 (36.1%)	61 (100%)	2.33
Variety in Work	7 (11.3%)	44 (71.0%)	11 (17.7%)	62 (100%)	2.06
Pleasant working conditions	13 (21.3%)	35 (57.4%)	13 (21.3%)	61 (100%)	2.00
Geographical location of jobs	14 (22.6%)	41 (66.1%)	7 (11.3%)	62 (100%)	1.89
Job Security	20 (32.3%)	32 (51.6%)	10 (16.1%)	62 (100%)	1.84
Good career opportunity	35 (56.5%)	21 (33.9%)	6 (9.7%)	62 (100%)	1.53

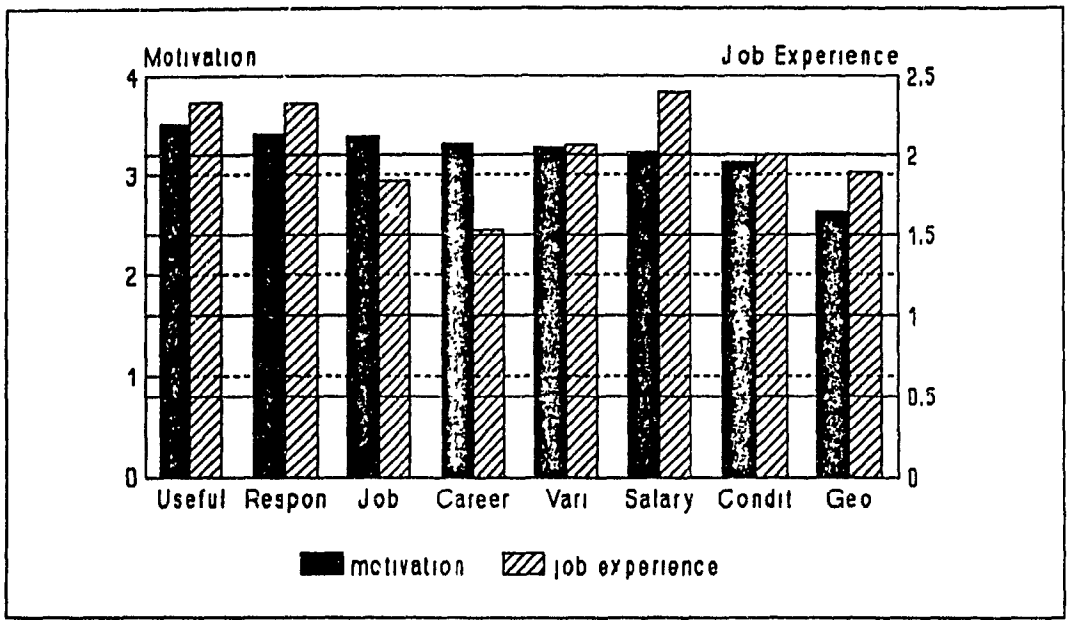
NOTE: Percentages may not add to 100 due to rounding.

What is important in Table 33 are the mean scores. Mean scores of 2 and above suggest that on the whole there is complete agreement between job experience and the expectations of respondents. Mean scores falling below 2 suggest that the job does not meet the expectation of dental therapists on those factors. It can be seen that the job experience is meeting the expectation of respondents in five of the eight factors. Where job experience is not measuring up to expectation is in the areas of "good career opportunity","job security" and "geographical location of the job".

It is interesting to check the importance of motivational factors (Table 32) against the actual job experience (Table 33). The purpose in extending the investigation in this direction is to determine if the job experience appeases the importance levels assigned to motivational factors by dental therapists. Since the units of measurement for each set of responses are different, the ratings were plotted on a dual Y axis to permit a meaningful comparison of the ratings of motivational factors with the ratings of subsequent job experience (Fig. 22).

It can be clearly seen in Figure 22 that the job experience compliments dental therapists' reasons for choosing a career in dental therapy on all factors except job security and career opportunity. "Geographical location of jobs", which respondents reported as not meeting their expectations, was nullified in Figure 22. There are two probable reasons for this. First, geographical location of the job ranked 8 and least important in the list of motivational factors (see Table 32). Second, "geographical location of jobs" and "good career opportunity" are intrinsically linked as the ensuing discussion will reveal.

Figure 22
Comparison of Motivational Factors to Job Experience



Useful=Socially Useful Job; Respon=High Level of Responsibility; Job=Job Security; Career=Good Career Opportunity; Vari=Variety in Work; Salary= Salary Level; Condit= Working Conditions; Geo=Geographical Location of Jobs.

Dental therapy as a "good career opportunity" presents the greatest gap between reasons for becoming a dental therapist (motivational factor) and subsequent job experience. There is strong evidence in the qualitative data provided by respondents (Appendix F and Appendix H) that there is conflict between the intentions of Health and Welfare Canada to train front line workers for a stimulating and satisfying career in a specific category, for which scarce human and financial resources have been allocated, and the inherent desire of dental therapists for promotion and change available through a career ladder both internal and external to the organization. Many dental therapists label their jobs as "dead-end" while others acknowledge pursuing

other unrelated education to increase their mobility and marketability both inside and outside of the federal government (Appendix E, F, and H).

Internal to Health and Welfare Canada, there is no clearly defined career structure which will permit the logical progression of dental therapists between dental therapy jobs. Progression within the federal public service currently requires dental therapists to abandon their training, their jobs and the communities they serve and be absorbed into government bureaucracy via other employment channels. On the part of Health and Welfare Canada, this could represent a sizeable loss from the training investment, and for dental therapists, it is the lost of what may otherwise be a stimulating career.

Dental therapists are not "credentialed" or recognized by a professional body. Most provincial dental practice acts differentiate the duties of dentists and dental auxiliaries. Since dental therapists lack professional recognition by dental associations, there is no provision for them in most provincial dental practice acts. Accordingly, dental therapists not working for the Crown may be deemed to be illegal practitioners. For this reason there are no employment opportunities for dental therapists in the private sector, thus obviating the possibility of a career path in dental therapy external to the Federal Government. Better career opportunities would palliate some of the concern about geographical location of positions since dental therapists would have more choices available to them including a wider choice of job sites.

"Job security" also did not measure up to the expectations of respondents. The matter of job security is a very recent issue among dental therapists and is related directly to the initiative of Health and Welfare Canada to transfer community-based

health services to Indian control (Appendix F and H). The recent emergence of the transfer initiative as an issue among dental therapists precluded the inclusion of questions in the survey instrument which would serve to probe the matter further. So that the reader may understand some of the probable reasons for the response made by dental therapists, the researcher has elected to provide a brief explanatory statement.

Since 1986 Health and Welfare Canada has undertaken extensive consultation with Indian communities and northern territories for the transfer of health services to local control. The decision to accept transfer of health services will be made by each Indian community. The range of health services comprising the transfer framework includes dental services.

Under the transfer initiative, the community will determine personnel requirements on the basis of the mix of services it will have specified in its community health plan. The community hea plan is an absolute prerequisite to transfer. It defines community health needs, establishes community health goals based on the defined needs, and outlines the services and delivery method intended to meet those goals. In some cases the necessary personnel may be very similar to those currently working for Health and Welfare Canada, but in other cases the community may wish to have different kinds of positions to deal with the priorities indicated in the health plan.

Dental therapists see the transfer of the dental therapy programs to Indian control as affecting them in several ways. First, Indian communities who accept transfer of health programs are under no obligation to continue the dental therapy program and have the right to use the dental therapy program resources for other priorities. Second,

Indian communities who choose to retain the dental therapy program are under no obligation to extend employment to the dental therapist employed in the community at the time of transfer. Third, some dental therapists who would be offered new employment by Indian communities feel insecure and uncertain in a system which they feel has not been tried and proven. Fourth, and final, dental therapists displaced from their positions and from Health and Welfare Canada as a result of transfer, cannot be legally employed as dental therapists outside of the Federal Government and its territories, except the provinces of Manitoba and Saskatchewan. For many this would mean an initial period of unemployment, retraining, and a probable loss of earning power.

The current reality is that dental therapists are trained, employed and supervised by the Federal Government. As servants of the Crown acting within the scope of their duties, they are not subject to provincial licensing practice, and they receive legal protection by the Crown in the event a suit is brought to court against them. Dental therapists employed by Indian bands would lose this protection and, with the exception of the provinces of Manitoba and Saskatchewan and the Yukon and Northwest Territories, would be considered to be illegal practitioners. A private dental practitioner employed by Indian bands to provide band-employed dental therapists with treatment plans and to supervise their work may be considered to be performing illegal acts which can cause the potential loss of one's license, fines or even imprisonment. Should the dentist be involved in a malpractice litigation arising from illegal delegation of duties, there would be no protection under the professional insurance coverage

which all dentists must carry. Accordingly, dental therapists are not directly employable by Indian bands. Nevertheless, a feeling of uncertainty prevails as the Federal Government continues to explore avenues and develop special interchange arrangements to turn control of the dental therapy program over to Indian Bands.

It may be concluded from the information depicted in Figure 22 that dental therapists are finding self-fulfillment by filling societal needs and purposes, feel they receive adequate remuneration, and are satisfied with working conditions. On the other hand, they report that their aspirations for job security and a career path are not being met by their job experience. Will this result in more attrition among dental therapists? Are some dental therapists more affected than others by these circumstances? Do they account for the direction of the obtained measures more than the others? In order to examine possible links between dental therapist variables outcome measures several statistical techniques were employed.

Job security

Since the question of job security appears to centre around the transfer of dental services to Indian control, the most meaningful comparison to make is the ratings of native and non-native dental therapists for job security. Is there a difference in the ratings of native and non-native dental therapists regarding "job security" at $\alpha = .05$? The null hypothesis, that there is no difference in the perceptions of native and non-native dental therapists regarding job security, was rejected, $t(60) = -2.06$, $p < .043$. The statistical data are reported in Table 34.

Table 34
Means, Standard Deviations, and *t*-Test Results for Ethnicity and Ratings of "Job Security"

	Number of Cases	Means	SD	Df	*t* ratio	*p* prob.
Non-native	44	1.73	.62	60	-2.06	.043*
Native	18	2.11	.76			

$p < .05$

A statistically significant difference was found between measures of job security and ethnicity of dental therapists. Dental therapists of native ancestry rated job security significantly higher than non-native dental therapists. Since the objective of the transfer initiative is to transfer control of Indian health services to Indian bands, the above results are as one might expect. Native dental therapists do not perceive the transfer as a threat to their future employment as dental therapists in native communities. This is further supported by the qualitative data drawn from the study. Some native respondents saw themselves as positive role models in native communities (Appendix D).

Dental Therapy as a Good Career Opportunity

Respondents in the study indicated that dental therapy does not represent the career opportunity they were anticipating when choosing a career in dental therapy. Furthermore, there is a significant positive correlation between ratings of job security and ratings of good career opportunity ($r = .51$, $p < .0002$). Since correlation does not establish causation, a number of variables were investigated to determine if there is a

subgroup within the population of dental therapists influencing the direction of the measure of "good career opportunity".

Dental therapists of native ancestry rated job security higher than non-native dental therapists. It may be theorized that they see dental therapy as a better career opportunity than non-native dental therapists, suggesting that non-native dental therapists are influencing the direction of the measure more than the native therapists. Is there a difference in the ratings of native and non-native dental therapists regarding dental therapy as a "good career opportunity" at $\alpha = .05$? The null hypothesis, that there is no difference in the perceptions of native and non-native dental therapists regarding "good career opportunity" could not be rejected, $t(60) = -1.88$, $p > .07$. The statistical data are reported in Table 35.

Table 35
Means, Standard Deviations, and *t*-Test Results for Ratings of "Good Career Opportunity"

	Number of Cases	Means	SD	Df	*t* ratio	*p* prob.
Non-native	44	1.43	.66	60	-1.88	.07
Native	18	1.78	.65			
Male	24	1.54	.72	60	.09	.931
Female	38	1.53	.68			

There is general agreement between native and non-native respondents regarding dental therapy as a "good career opportunity". The data also show that both groups do not perceive dental therapy as having a good career path (means 1.43 and 1.78 vs. 2+).

Is there a difference in the ratings of male and female dental therapists regarding dental therapy as a "good career opportunity" at $\alpha = .05$ level? The null hypothesis, that there is no difference in the perceptions of male and female dental therapists regarding "good career opportunity" could not be rejected, $t(60) = .09$, $p > .931$. The statistical data are reported in Table 35.

There is nearly an identity of views between male and female respondents regarding dental therapy as a good career opportunity. It also shows that both groups do not perceive dental therapy as providing a good career path (means 1.54 and 1.53 vs. 2+).

Are there differences in the ratings of dental therapists of different educational backgrounds regarding dental therapy as a "good career opportunity"? The means and standard deviations for the measures are reported in Table 36.

Table 36
Means and Standard Deviations for Ratings of "Good Career Opportunity" by Educational Level

	Mean	SD	Cases
Entire Population	1.5323	.6706	62
High School			
Some	1.0000	.0000	2
Completed	1.5500	.6863	20
Community College			
Some	3.0000	.0000	1
Completed	1.5294	.6243	17
University			
Some	1.5000	.7303	16
Completed	1.5000	.5477	6

Table 36 contains basic descriptive statistics for the ratings of "good career opportunity" by dental therapists of different educational levels. With the exception of dental therapists with some community college preparation, all other groups of dental therapists do not regard dental therapy as a good career path. A oneway ANOVA was applied to determine if a true difference exists between the observed ratings.

The oneway ANOVA revealed that there is insufficient evidence to reject the null hypothesis at $\alpha = .05$. There is no significant difference in the perceptions of dental therapists of varying academic preparation regarding "good career opportunity": $F(5,56) = 1.25$, $p > .30$. There is a strong similarity of views among dental therapists of varying academic background regarding dental therapy as a good career opportunity. The statistical data are reported in Table 37.

Table 37
Analysis of Variance for Ratings of "Good Career Opportunity" by Educational Level

	Sum of Sqs	Df	Mean Sq	*F* Ratio	*P* Prob.
Between Groups	2.7502	5	.5500	1.248	.299
Within Groups	24.6853	56	.4408		
Total	27.4355	61			

Are there differences in the number of years a respondent has been a dental therapist and the ratings given to dental therapy as a "good career opportunity" at $\alpha = .05$? The means and standard deviations for the measures are reported in Table 38.

Table 38
Means and Standard Deviation for Ratings of "Good Career Opportunity" by Years of Experience

	Mean	SD	Cases
Entire Population	1.5323	.6706	62
<1 year	1.6250	.7440	8
1 - 2	1.8000	.4472	5
3 - 4	1.9167	.7930	12
5 - 6	1.8000	.6325	10
7+	1.1852	.4833	27

Table 38 contains basic descriptive statistics for the ratings of "good career opportunity" by dental therapists with different levels of experience. All respondents reported that they do not feel dental therapy is providing the career structure they expected. Differences, however, in the intensity of those feelings are observed among the reported means. A oneway ANOVA was applied to ascertain if a true difference occurs between the observed ratings.

The oneway ANOVA revealed that the null hypothesis, that all means are equal, is rejected at $\alpha = .05$: $F(4,54) = 4.13$, $p < .005$. It appears unlikely that dental therapists with different years of experience have the same degree of perception of dental therapy as a "good career opportunity". The statistical data are reported in Table 39.

The *F* statistic in Table 39 indicates that the population means are unequal. The *Scheffé post hoc* multiple comparison procedure revealed that dental therapists with 3 to 4 years experience were significantly different from dental therapists with 7+ years experience. No other pair was found to be statistically significant. These data are reported in Table 40.

Table 39
Analysis of Variance for Ratings of "Good Career Opportunity" by Years of Experience

	Sum of Sqs	Df	Mean Sq	*F* Ratio	*P* Prob.
Between Groups	6.1697	4	1.5424	4.134	.0052
Within Groups	21.2657	57	.3731		
Total	27.4355	61			

The data in Table 40 warrant further interpretation. The group means are ordered from smallest to largest. Dental therapists with 7+ years of experience account for more dissatisfaction with dental therapy as a good career opportunity than any other group. The 7+ group is reported to be significantly different, at $\alpha = .05$, only from dental therapists with 3 to 4 years experience. This is because the *Scheffé* multiple comparison procedure is one of the most conservative and is very likely to miss detecting a real difference that exists (Dowdy & Warren, 1983). An additional application of the LSD (Least Significant Difference) multiple comparison procedure to the data revealed additional differences. It revealed a difference between dental therapists with 7+ years experience and dental therapists with 1 - 2 and 5 - 6 years experiences. Thus dental therapists with less than one year's experience and dental therapists with 7+ years experience appear to account for the significant difference found in the oneway ANOVA.

Future Job Change

Dental therapists appear to speak with one voice when they report that dental therapy does not provide the career opportunities they were anticipating when choos-

Table 40
The Scheffé Multiple Comparison Ratings of "Good Career Opportunity" and Years of Experience.

(*) Denotes pairs and groups significantly different at α .050 level.

Mean	Group	7+	<1	1 2	5 6	3 4
1.1852	7+					
1.6250	<1					
1.8000	1-2					
1.8000	5-6					
1.9167	3-4	*				

ing dental therapy as a career. The non-native dental therapists also report greater disillusionment with job security than native dental therapists. It is informative to investigate the relationship among these findings and reports of future job change.

Dental therapists were asked if they will continue to work as dental therapists in Indian and northern communities in two years time. To answer this question, dental therapists were given four responses on an ordered scale from which to select one: "very likely," "quite likely," "not very likely," or "not at all likely." Owing to small numbers in some categories, it was necessary to combine ratings of "very likely" and "quite likely" into one category labelled "yes", and "not very likely" and "not at all likely" into a second category labelled "no".

Do dental therapists who state a likelihood of leaving their positions in two years time also tend to score job security lower? The null hypothesis that there is no significant correlation between indications of future job change and job security was

rejected at $\alpha = .05$ level ($r_{pb} = .27$, $p < .04273$). There is a significant correlation between ratings for job security and indication of future job change. The statistical data are reported in Table 41.

The data in Table 41 show that dental therapists who indicate a future job change also tend to rate job security lower than those who do not indicate a future job change. Care must be taken in interpreting these results. The data do not necessarily mean that dental therapists who rate job security lower are seeking or plan to seek alternative employment. It may simply mean that they believe they will be displaced from their present jobs as dental therapists as a result of the transfer of the dental therapy program to Band control.

Table 41
Means and Standard Deviations of Future Job Change and Ratings for Job Security

	Mean	SD	Cases
For Entire Population	1.8387	.705	62
Yes = Likely to be working	1.9545	.705	44
No = Not likely to be working	1.5565	.645	18

$r_{pb} = .27$, $p < .04273$

Is there a tendency for dental therapists who indicate a future job change to also score "good career opportunity" lower? The null hypothesis that there is no significant correlation between indications of future job change and "good career opportunity" was rejected at $\alpha = .05$ ($r_{pb} = .24$, $p < .0380$). There is a significant correlation

between ratings for "good career opportunity" and indication of future job change. The statistical data are reported in Table 42.

The data in Table 41 show that dental therapists who indicate a future job change also tend to rate "good career opportunity" lower than those who do not indicate a future job change. Care must also be taken in interpreting these results. The data do not necessarily mean that dental therapists who rate "good career opportunity"

Table 42
Means and Standard Deviations by Future Job Change and Ratings of "Good Career Opportunity".

	Mean	SD	Cases
For Entire Population	1.5323	.671	62
Yes = Likely to be working	1.6364	.685	44
No = Not likely to be working	1.2778	.574	18

$r_{pb} = .24, p < .0380$

lower are seeking or plan to seek alternative employment. It may also mean that they will be temporarily away on educational leave to pursue academic qualifications in a recognized profession. Alternatively, they will seek employment else where in the public service along different career paths.

Dental therapists of native ancestry rated job security significantly higher than non-native dental therapists (see Table 34). It may therefore be predicted that there is an association between ethnicity of dental therapists and indication of future job change. The null hypothesis that there is no significant correlation between ethnicity

of the dental therapist and indication of future job change could not be rejected at α = .05 level (ϕ = .17, p > .17). The statistical data are reported in Table 43.

The data in Table 43 did not produce a significant correlation between ethnicity of dental therapists and indication of future job change. Furthermore, the extremely weak positive relationship is not in the predicted direction. That is, yes on one measure is not associated with no on the second measure. There appears to be no correlation between ethnicity of dental therapists and indication of future job change.

Table 43
Correlation between Ethnicity of Dental Therapist and Indication of Future Job Change

	Job Change?		
	Yes	No	
Non-native = Yes	15	29	44
Native = No	3	15	18
	18	44	

ϕ = .17424, p > .17007

Job Satisfaction

The first phase of this study concentrated on the economic analysis of the market value of work produced by dental therapists. The economic analysis revealed that aggregated benefits of the study group exceeded its aggregated costs (Table 21, Fig. 19). According to Mathis and Jackson (1982) there is a dynamic relationship between employee productivity and job satisfaction. Greater productivity results from having

satisfying jobs, and a job which is deemed satisfying and rewarding is a powerful stimulus for improving productivity.

In the light of the earlier findings regarding dental therapists' perception of job security and apparent disillusionment with dental therapy as a good career opportunity, and the foregoing discussion on job satisfaction and productivity, one would wonder if job satisfaction has been compromised in some way. Such an effect can be expected to have a downward compression on productivity which impacts on the economic efficiency of the program, either now or in the future.

How satisfied are dental therapists with their work? To answer this question dental therapists were asked to report how satisfied they were with the job in general, their salary, the number of hours they work, the schedule of work hours and the tasks and duties they perform. Responses were assigned from 1 to 4 points - 4 points for very satisfied and 1 point for dissatisfied. The results are presented in Table 44.

Table 44 sets forth dental therapists' perceived level of satisfaction with factors associated with job satisfaction. What is important in the table is the mean score listed for each factor. A mean score of 3 and above suggests dental therapists are "quite satisfied" with the factor. As can be seen in the table, all mean scores fall above 3 and the overall rating for job satisfaction is 3.139. Dental therapists appear to be "quite satisfied" with all of the identified aspects of their job, and with the job in general.

There may appear to be some incongruence between dental therapists' perception of job security, perception of dental therapy as a good career opportunity and ratings

for job satisfaction. It may be that the question of job security and a career structure reached prominence only recently with the transfer initiative. On the other hand it is erroneous to deduct that dissatisfaction with job security and the desire for a career structure are the same as objection with the present job. The manner in which dental therapists responded to the various questions suggests they find their jobs acceptable and the rewards adequate, but they should not be denied opportunities for promotion and, given the limited marketability of their acquired skills, they should be entitled to a greater degree of job security.

Table 44
Dental Therapists' Ratings of Job Satisfaction

	Dissatisfied (1)	Not Very Satisfied (2)	Quite Satisfied (3)	Very Satisfied (4)	N	Mean Score
The Job in General	2 (3.2%)	4 (6.5%)	42 (67.7%)	14 (22.6%)	62	3.097
Your Salary	0 (0%)	11 (17.7%)	32 (51.6%)	19 (30.6%)	62	3.129
Number of Hours Your Work	2 (3.2%)	2 (3.2%)	44 (71%)	14 (22.6%)	62	3.127
The Schedule of Working Hours	1 (1.6%)	0 (0%)	42 (67.7%)	18 (29.5%)	61	3.262
The Things You Do	2 (3.3%)	10 (16.1%)	31 (50%)	19 (30.6%)	62	3.081
Overall Rating						3.139

Note: Percentages may not add to 100 due to rounding.

Summary

Since 1972 Health and Welfare Canada has actively trained and employed dental therapists to provide basic dental care services in Indian and northern communities of Canada. The purpose of this chapter has been to analyze the economic returns of the dental therapy program from the perspective of Health and Welfare Canada. The economic returns were assessed by using a cohort of 32 dental therapists who are believed to be representative of the program in every respect. The results of the economic analysis indicate that the economic benefits of the program in terms of cost avoidance to Health and Welfare Canada exceed the cost of training and employing dental therapists. More succinctly, it not only does not cost the Federal Government any money to operate the program, the Federal Government also "gains" revenue in terms of a net benefit which exceeds the cost of operating the program.

The benefits of the program which accrue to Health and Welfare Canada for training and employing dental therapists are more than the explicit measures of avoided costs. Benefits are also measured in terms of the degree to which dental health has improved in the community as a whole. In that regard, the quality of care study revealed that dental restorations placed by dental therapists are equal to but more often better than those placed by dentists serving the same population. This represents an additional cost-savings to Health and Welfare Canada which was not included in the economic analysis. Two intermediate outcome measures in the form of the ratio of restorations to extraction and the ratio of restorations to preventive work provided two very strong lines of evidence that the dental therapy program is being successful

in improving the dental health of communities which they serve.

One premise of this study was that there is a relationship between the predisposition and attitudes of dental therapists toward their jobs and subsequent productivity (benefits) and quality of care. Dental therapists reported that they are "quite satisfied" with their jobs which is not surprising in view of the degree of productivity and very high levels of care which were found in the present study. However, respondents reported that job security and career structure fell short of their expectations of those factors when selecting a career in dental therapy. The concern with job security was found to be stronger among non-native than native dental therapists, but the concern with the lack of a career structure appears to be shared equally among all dental therapists.

CHAPTER VII

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The objectives of this study were two-fold: to propose an analytical model for assessing the costs and benefits of training and utilizing auxiliary health personnel, and to apply the model to the Canadian Dental Therapy Program. The analytical model was developed using Flamholt's (1978) principles of human resources accounting and Kaufman's (1988) the Organizational Elements Model. The model provided the framework for assessing the costs and benefits of the Canadian Dental Therapy Program.

Since 1972 Health and Welfare Canada has been actively training and employing dental therapists to provide basic dental care services in Indian and northern communities. Although the dental therapy concept is not new, it is the only program of its kind in North America. The present study assessed the costs and benefits of training and employing dental therapists from the viewpoint of Health and Welfare Canada. The study was carried out in three separate but interrelated phases related to the economic analysis of the program, the quality of dental care provided by dental therapists, and the predisposition and attitudes of dental therapists toward their job. The results of the study must be considered very favourable.

The economic analysis of the dental therapy program utilized a cohort of 32 dental therapists who were followed up from the time of enrolment in the training program,

subsequent employment with Health and Welfare Canada and/or the Government of the Northwest Territories, to date of termination or June 30, 1990, whichever came first. The costs associated with the training and employment of the members of the cohort were identified. The benefits were quantified by assigning a market value to the dental services produced by the same group. This was done by identifying the types and frequency of services occurring in a given year and costing them out using the appropriate annual provincial dental fee guide.

The time frame of the economic analysis was July 1, 1984 to June 30, 1990. Taking all factors into account, the analysis arrived at a positive net present value for the cohort. Since the cohort was considered representative of the Dental Therapy Program in most respects, the positive net present value finding was generalized to the entire program.

The quality of care phase of this study examined the quality of clinical care and the quality of community care provided by dental therapists. The quality of clinical care study revealed that dental therapists trained under the auspices of Health and Welfare Canada provide a very high standard of treatment service. The quality of six types of dental restorations placed by dental therapists, when compared with the same types of restorations placed by dentists serving the same population, were at least equal to, but more often better than, those placed by the dentists. These results are consistent with those reported by other researchers on "expanded duty dental auxiliaries" (Abramowitz & Berg, 1973; Ambrose, Hord, Simpson, 1976; Brearley & Rosenblum, 1972; Hord, Thompson, & Ellis, 1974; Hammons, Jamison, & Wilson,

1971; Romcke & Lewis, 1973; Rosenblum, 1971).

The quality of community care was examined using measures of intermediate outputs in the form of the ratio of dental restorations to extractions and the ratio of dental restorations to preventive work. Both ratios revealed a steady trend toward better dental health in communities served by dental therapists. A strong negative correlation was also found between the number of extractions and restorations performed by dental therapists and the amount of preventive work done. Although correlation does not equate to causation, the implication in this study was that the increase in preventive work and dental health education activities in the schools and communities where dental therapists are employed resulted in a decrease in demand for dental emergency care and restoration services. It is believed that this trend will result in further decrease in demands for clinical dentistry services. Therefore, the dental therapy program may be justified on the grounds of savings in future treatment expenditures alone.

Turning to the results of the survey of the predispositions and attitudes of dental therapists toward their jobs, on a scale from 1 to 4 dental therapists rated satisfaction with their job in general as 3.097, and satisfaction with their salary as 3.129, thus indicating that they find their jobs acceptable and the (material) rewards adequate. This apparent high level of job satisfaction is undoubtedly an important underlying factor in the favourable cost-efficiency of the program and the high level of care dental therapists are providing to clients and to communities. Dental therapists, however, express two important and interrelated concerns: the lack of a career

structure and anxiety about future job security, the latter expressed more often by non-native dental therapists.

A career structure, internal and external to Health and Welfare Canada, would palliate much of the concern about job security. A career structure external to Health and Welfare Canada includes career pathing within and outside the Federal Government. Within the Federal Government other departments responsible for providing direct dental care services to clients include the Solicitor General (Correctional Service Branch), Veterans Affairs, and National Defense.

Human capital theory decrees that as employment opportunities for dental therapists increase, federal support to training will decrease in favour of more student-paid tuition, fees, books, and uniforms.

Conclusions

The results of this study lead to conclusions regarding (1) the proposed analytical model for assessing the costs and benefits involved in the training and utilization of auxiliary health personnel, (2) the potential for integrating dental therapists into the oral health care delivery system of Canada, and (3) the contributions of this study to theory and practice in educational technology.

The Analytical Model

The analytical model proposed and used in this study attempts to identify and place into relationship the synthesis of people and resources needed to train and utilize

auxiliary health personnel. The input of people and re , es in this process generates costs. The model also attempts to identify one of the results which may be expected when an institution decides to undertake the training and utilization of auxiliary health personnel. The results of the training and utilization scheme generate benefits to the institution which are measured in monetary form.

The proposed analytical model, as a model, is by definition an over-simplification of a scheme for training and employing auxiliary health personnel. The fidelity of the model to an actual process depends on the degree to which the process and the model are similar in detail. In this respect, the synthesis of people and resources and the expected results for employing auxiliary health workers with one week of training are quite different from an auxiliary health worker program with over one year of training. Therefore, the present model will not map perfectly onto all training and utilization schemes. The merit in the present model is that it provides a conceptual framework for making the necessary boundary adjustments.

In terms of the economic benefits which accrue from the training and utilization of auxiliary health personnel, it must be recalled that in a cost-benefit study a benefit is an outcome which is quantifiable in money terms. Where the major thrust of auxiliary health personnel's activities is in transforming the process of service delivery, that is, activities centred around process measures such as "teaching", "referring", "counselling", "community mobilization", "supporting", and "surveillance", benefits may be difficult if not impossible to quantify in money terms. In this case the recommended assessment is cost-effectiveness analysis where the economic analysis is

expressed in cost per physical unit (e.g., cost per trainee, instructor, hour, service delivered, service recipient, etc.). As a general rule, the more the mix of tasks taught and assigned to auxiliary health personnel is of sufficient biological efficacy to result in more immediate health impacts, the more the model in this study lends itself to cost-benefit analysis, since there are several ways of measuring the economic benefits of health impact (e.g., cost avoidance, productivity, earning power, health savings such as cost-benefit aspects of auxiliary produced immunization campaigns, education savings).

Future Role of Dental Therapists in the Canadian Dental Health Care Delivery System

The results of this study cannot but lead to at least some rudimentary speculation regarding the future role of dental therapists in the Canadian dental health care delivery system. In the past arguments against official acceptance and recognition of dental therapists in Canada have been structured around the purported surplus of dentists in Canada and the worldwide decline of dental caries. The following comments are directed to these two issues.

There is a large body of literature, derived from empirical studies, which demonstrates the technical feasibility of training and utilizing expanded duty dental auxiliaries (i.e., dental therapists) to provide a wide spectrum of service with quality standards at least equal to those achieved by most dentists. The dental profession is no different from any other profession in attempting to suppress the entry into the marketplace of people who they feel will be selling services which will compete

directly with those they offer. The fear of career encroachment by dental therapists is therefore understandable, but it lacks a rational basis. Dental therapists, as a group, are controlled in several ways, not least of which is that diagnosis and treatment planning are excluded from their scope of practice. Accordingly, dental therapists cannot operate except under the supervision of a dentist and cannot initiate care except on treatment plans provided to them by a dentist. Therefore, the dental therapists' independence from dentists may be described as nil. Restricting dental therapists' access to the service market may be a disservice to the dental profession as seen in the failure of the profession to take up the opportunity to hire such personnel which would expand dentists' productivity.

There is a purported surplus of dentists in Canada. This supposes there are no geographical disparities in the distribution of dental manpower. Figure 2 (Chapter II) suggests the surplus may not be evident. Although there is a general problem of maldistribution of dentists, there is no evidence of aggressive competition for patients in urban areas which have a larger concentration of dentists.

In 1989 the dentist/population ratio in Canada reached 53 per 100,000. Concealed in this figure are the variable proportions of dentists in part-time practice and those working in institutional settings not directly linked to the production of dental services. Concurrently, most provinces have an undersupply of dentists in proportion to their share of the nation's population. These observations along with the lack of evidence of aggressive competition among dentists for patients suggest the claims of dental manpower surplus cannot be evidenced by all indicators.

If overproduction of dentists in Canada is a problem, it may be because adequacy in numbers has been expressed in terms of dentists to population ratio. The training and utilization of dental auxiliaries can help correct the imbalance where adequacy in numbers will not be expressed in terms of the population but in terms of the number of dentists to auxiliaries. This would not reduce dentists' control on dentistry, and it would not have an effect on dentists' economic well-being, except to control the "glut" of dentists in the marketplace.

The reported surplus of dentists may also be examined from the perspective of third-party payment systems. It is a fact that the demand for dental services is restrained by the price of dental services and the income of the consumers. It is also a fact that in Canada there is a steady trend towards oral health services for more Canadians being financed by third-party payment systems where participation of the patient in the payment of dental services is small. Where cost barriers are lowered, demand naturally grows. As third-party payment systems continue to reach more Canadians, so will the demand for dental services. The primary effect is that the "excess" in dental manpower will be absorbed by the growth in demand. A secondary effect will be an increase in the supply of dentists, eventually returning the system back to the state from which it is seeking escape. This situation may be avoided by a more balanced dental health system which makes better use of trained dental auxiliaries rather than producing more dentists.

Throughout the 20th century, caries have been the "bread-and-butter" of the dental industry. Accordingly, the major focus of dental curricula has been on the teaching of

procedures designed mainly to relieve pain and provide restorative and rehabilitative treatment. Recently, however, a new issue has emerged which will certainly influence the need and demand for oral health services. This is the reduction in the prevalence of dental caries throughout the industrialized world. Reports are that these reductions are not transitory, but are carrying over into young adults.

It can be expected that changing disease patterns, demographic changes resulting from aging, and oral care technology will have a profound effect on the need and demand for traditional oral health services. The continual production of dentists to meet a diminishing demand will most certainly lead to a surplus of dentists. The newer needs and demands for oral health services point to changes in the roles and functions of dentists and thus in their education and training.

With the demand for simple treatment declining, present and future dentists should be increasing their clinical skills to attend to a wider range of oral conditions and diseases. Technical procedures such as radiographs, extractions, fillings, pins, crowns, polishing, scaling, topical fluoride, etc. should be assigned to dental auxiliaries employed in dental offices. Accordingly, the cost of educating dentists and using them as they are currently trained to perform, may be wasteful when many of the current tasks can be delegated to auxiliaries.

Contribution of the Present Study to Theory and Practice in Educational Technology

Over the past decade the literature in educational technology has given increasing attention to the role of cost-effectiveness analysis and cost-benefit analysis in serving

educational decisions. If we accept Romiszowski's (1981) definition of technology as the creative application of science to solve problems, we can infer that educational technology is the creative application of science to solve problems in education. Technology in education is of two sorts: tangible products such as computers and videodiscs, and processes such as training and the development of teaching/learning experiences. Since cost is invariably a decisive factor in the use of any form of technology, interest in economic analysis should be fundamental to educational technology.

Although the literature in educational technology stresses the need for cost effectiveness analysis and cost benefit analysis, and provides several detailed models of the methods of both forms of analyses, there are still few applied studies. More recently there has been a call for applied cost-benefit analyses of corporate training programs, a form of training evaluation rarely used or infrequently reported in the research literature.

Contemporary corporate education is generally viewed as training and education provided internally and externally to a firm's employees. Hawthorne (1986) maintains that this is affected by conditions external to the firm, by competitive forces within a given industry, or the nature of a company's business. In any case the expectation is that training will yield benefits to the firm commensurate to the resources consumed, or training should not be funded by the employer. Therefore, economic evaluation of investments in corporate training, as called for in the literature, is useful to corporate managers and managers of training as an evaluation technique to answer questions

about the economic value of human resources development at the firm's expense.

It is important to recall that for some firms training is the only way the firm can acquire the pool of labour with which to operate. This form of employee training falls outside the traditional view of corporate education. In such situations specific training provided by the firm is a prerequisite to employment of successful graduates by the firm. The only sound business reason for this approach to employee training is that the full cost of training and subsequent employment of successful graduates will be totally off-set by the employees' contribution to the productive process. The economic evaluation of this type of corporate training is perhaps the most inadequately documented in the research literature. The present study makes a useful contribution to the research literature on applied cost-benefit studies of employee training programs by providing a flexible model for cost-benefit analysis of corporate training-and-employment programs, and the application of the model to an actual situation.

One plausible reason economic evaluation of corporate training-and-employment schemes are not undertaken is because of the perception that training costs are diffused throughout the firm such that no one pays substantially for the training. The present study proceeded on the assumption that the total cost of training must be absorbed by the successful graduates completing training and subsequently employed by the firm. The cost of this type of training in the present study is diffused only among employees who are graduates of the program. For the program to be cost-efficient, employed graduates, individually and collectively, must generate ample benefits to satisfy the costs of training and employment.

The present study recognizes that straight forward monetizing of all quantifiable variables in cost-benefit analysis is not the final arbiter of the economic worth of programs for the training and employment of auxiliary health personnel. An important concept introduced in the study is the importance of quality of care and its quantification in relation to program benefits in rendering the evaluative judgement. Training programs for auxiliary health personnel are generally based on learning objectives related to the kinds and adequacy (in quantity and quality) of services rendered by the care giver. An economic evaluation of the training program must not only quantify the services rendered, but must also shed light on the quality of care given.

Quality of care is unquestionably the most important intangible benefit of training programs for health care providers. One of the leading objections to cost-benefit analysis is that one cannot relate program benefits to program costs where program costs are expressed in dollars and some of the most important benefits (i.e., quality of care) are in nonmonetary units. An important contribution of the present study to the research literature was the two ways in which quality of care was monetized. First, the quality of care study revealed that the performance of dental therapists in restorative dentistry was equal to, but more often better than, that of dentists providing the same restorative services to the same population group. This favourable quality of care finding gave validity to the use of dental fees charged by dental practitioners to establish the pecuniary effects of the work done by dental therapists. Second, monthly productivity figures produced by dental therapists do not reveal the extent to which

services may have been provided repetitively and inappropriately resulting in additional costs in terms of wasted human resources and added material. The superior performance of the dental therapists as compared to dentists strongly suggests that resources were not being wasted by dental therapists in providing services inappropriately and repetitively. In that same vein, the assessment of dental restorations provided by dentists and dental therapists revealed that the dentists had a failure rate of 11.4 percent whereas dental therapists had a failure rate of only 2.5 percent. This has direct implications to the economic analysis of the program. A gain in quality represents a gain in resources (Abramowitz & Mecklenburg, 1972). The difference between the two failure rates is 8.9 percent or a 9 percent gain in resources directly attributable to the dental therapy program.

Recommendations

The results of this study generate two categories of recommendations: program recommendations and recommendations for further research.

Program Recommendations

1. The rising cost of health services in Canada in general and of Non-Insured Health Benefits of Health and Welfare Canada in particular, causes federal policy-makers to see health services as a form of consumption rather than investment. The cost-benefit assessment of the training and utilization of dental therapists by Health and Welfare Canada to provide basic dental care services in Indian and northern

communities has demonstrated that the dental therapy program is an extremely cost-effective use of resources which supports the Federal Government's cost-containment policies. The economic analysis of the dental therapy program along with the quality of care findings in the study reveal that dental therapists can treat patients with high quality of care at virtually no cost to the Federal Government (the cost savings in Non-Insured Health Benefit dollars justifies the costs of training and employing dental therapists). Furthermore, federal investment in the dental therapy program may be regarded as an investment in the aboriginal population's standard of living and general well-being.

It is recommended that the dental therapy program in the various regions be excluded from any regional work force adjustment policies and that, in view of the quality of care provided by the program and the positive net present value generated by the program, it be expanded to other Indian and northern communities without free access to on-going dental health services.

2. The study found that on the whole dental therapists are satisfied with their jobs and their level of remuneration. However, an important conflict was found between dental therapists' desire for a better career structure and job security and the intention of Health and Welfare Canada to provide front line dental health personnel in Indian and northern communities. The study likewise found a significant correlation between dental therapists' low ratings of dental therapy as a good career opportunity and dental therapists' indications of future job change. Additional evidence which supports these findings is the number of dental therapists who are pursuing advanced studies in

unrelated fields.

It is recommended that greater importance be given to a more clearly defined career structure, both internal and external to Health and Welfare Canada, which will allow easy movement up the health career ladder; specific consideration should be given to advanced training for supervisors and trainers and for management positions within Health and Welfare Canada, to job opportunities in other Government departments providing direct dental care to client groups, and to the recognition and acceptance of dental therapists by dental associations and dental professionals.

Recommendations for Further Research

Based on the results of this study and the review of the literature, the following recommendations for further research are made.

1. Further research is suggested using dentists as a comparison group. Such comparisons should include the number of dental services provided by dentists and dental therapists, expenditures per capita for dental services by dentists and dental therapists, a comparison of the cost of services performed by dental therapists as compared to the cost of the same services performed by dentists, and the ratio of restorations to extractions by dental therapists as compared to dentists.

2. The benefits calculated in this study were the total benefits accruing from all dental therapists in the cohort which also represented all regions. The benefits in this study were calculated using the appropriate annual provincial dental fee guide. In 1990 one Relative Value Unit or its equivalent ranged from as little as $21.70 in the

Province of Saskatchewan to $45.00 in the Yukon. This suggests that there are regional differences in the cost-efficiency of the dental therapy program. It is recommended that this study be replicated at the regional (provincial) level.

3. Not all of the important benefits of the dental therapy program can be measured in money terms. Some of the most important effects of auxiliary health worker programs are intangible. Aside from the quality of care issue, the present research suffers from too little qualitative data on the noneconomic (intangible) benefits of the dental therapy program. Further research into the non-efficiency effects of the program is therefore indicated.

REFERENCES

Abramowitz, J. & Mecklenburg, R. (1972). Quality of care in dental practice: the approach of the Indian Health Services. Journal of Public Health Dentistry, 32(3), 90-99.

Abromowitz J, & Berg, L. E. (1973). A four-year study of the utilization of dental assistants with expanded functions. Journal of the American Dental Association, 87, 623-635.

Abbatt, F. & Mejia, A. (1988). Continuing the Education of Health Workers. Geneva: World Health Organization.

Abel, R. (1981). What primary health care workers are. The Training and Support of Primary Health Workers. Washington, D.C.: National Council for International Health

Abel-Smith, B. & Leiserson, A. (1978). Health, Development, and Health Policy. Public Health Paper 69. Geneva: World Health Organization.

Ackoff, R. & Sasieni (1969). Fundamentals of Operations Research. New York: John Wiley.

Allred, H. (1977). The Training and Use of Dental Auxiliary Personnel (Public Health in Europe 7). Copenhagen: World Health Organiation, Regional Office for Europe.

Allred, H. & Hobdell, M. H. (1986). The Planning and Development of Educational Programmes for Personnel in Oral Health. (WHO Offset Publication No. 93). Geneva: World Health Organization.

Ambrose, E. R., Hord, A. B. & Simpson, J. W. (1976). A Quality Evaluation of Specific Dental Services Provided by the Saskatchewan Dental Plan. Regina, Sask: Saskatchewan Department of Public Health.

Anderson, R. E., & Kasl, E. S. (1982). The costs and financing of adult education and training. Lexington, Mass: Lexington Books.

Andrews, D. H., & Goodson, L. A. (1980). A comparative analysis of models in instructional design. Journal of Instructional Development, 3(4), 2-16.

Andrieu, M. (1977). Benefit cost evaluation. In. L. Rutman (ed.), Evaluation Research Methods: A Basic Guide. Beverly Hills: Sage Publications.

Anthony, R. N. & Young, D. W. (1984a). Cost accounting. Management Control of Nonprofit Organizations (pp. 139-179). Homewood, Illinois: Richard D. Irwin, Inc.

Anthony, R. N. & Young, D. W. (1984b). Program analysis. Management Control in Nonprofit Organizations (pp. 315-355). Homewood, Illinois: Richard D. Irwin, Inc.

Austin, J. E. (1978). The perilous journey of nutrition education. American Journal of Clinical Nutrition, 31(12), 2324-2338.

Babbie, E. R. (1973). Survey Research Methods. Belmont, California: Wadsworth Publishing Co. Inc.

Backstromm, C. H. & Hursh, G. (1963). Survey Research. Evanston, Illinois: Northwestern University Press.

Baker, T. D. (1978). Productivity. In T. Hall & A. Mejia (Eds.), Health Manpower Planning: Principles, Methods, Issues. (pp. 117-132). Geneva: World Health Organization.

Barmes, D. (1969). The need for auxiliaries in developed as well as in developing countries. International Dental Journal, 19(1), 1-10.

Bartel. A. P., & Borjas. G. J. (1977). Specific training and its effects on the human capital investment profile. Southern Economic Journal, 44, 333-346.

Barsby, Steve L. (1972). Cost-Benefit Analysis and Manpower Programs. Toronto: Lexington Books.

Baum, W. C., & Tolbert, S. M. (1985). Investing in Development: Lessons of World Bank Experience. Toronto: Oxford University Press.

Becker, G. S. (1964). Human Capital. New York: National Bureau of Economic Research, Columbia University Press.

Bedford, W. & Davey, K. (1987). The international collaborative oral health development project. International Dental Journal, 37(4), 212-214.

Berki, S. E. (1973). The economics of new types of health personnel. In V.W. Lippard & E.F. Purcell (Eds.), Intermediate-Level Health Practitioners (pp. 104-134). New York: The Josiah Macy, Jr. Foundation.

Berman, P. A. (1984). Equity and Cost in the Organization of Primary Health Care in Java, Indonesia. Unpublished doctoral dissertation, Cornell University, Ithaca, N.Y.

Berman, P. A., Gwatkin, D. R., & Burger, S. E. (1986). Community-Based Health Workers: Head Start or False Start Towards Health for All. A World Bank Report (PHN Technical Note 86-3). World Bank: Washington, D.C.

Birch, S. & Donaldson, C. (1987). Cost-benefit analysis: dealing with the problems of indivisible projects and fixed budgets. Health Policy, 7, 61-72.

Blomberg, Robert (1989). Cost-benefit analysis of employee training: A literature review. Adult Education Quarterly, 39(2), 89-98.

Bloom, Martin (1986). Hygieia at the scales: Weighing the costs and effectiveness ofprevention/promotion with special reference to mental retardation. The Journal of Primary Prevention, 7, 27-48.

Blum, H. L. (1974). Planning for Health: Development and Application for Social Change Theory. New York: Human Sciences Press.

Bogue, D. J. (1969). Principles of Demography. New York: John Wiley and Sons, Inc.

Boissoneau, R. (1980). Continuing Education in the Health Professions. Rockville, Maryland: Aspen Systems Corporation.

Borg, W. R. & Gall, M. D. (1983). Educational Research: An Introduction. New York: Longman.

Bootman, J., Rowland, C., Wertheimer A. (1979). Cost-benefit analysis: A research tool for evaluating innovative health programs. Evaluation and the Health Professions, 2(2), 129-154.

Borgiel, A. E, Williams, J. I., Anderson, G., Bass, M., Dunn, E., Lamont, C., Spasoff, R. & Rice, D. (1985). Assessing the quality of care in family physicians' practice. Canadian Family Physician, 31, 853-862.

Brearley, L. J. & Rosenblum, F. N. (1972). Two-year evaluation of auxiliaries trained in expanded duties. Journal of the American Dental Assocation, 84(3), 600-610.

Breslow, L. (1980). Personal Hedalth Care. In J. Last (Ed.), Maxcy-Rosenau Public Health and Preventive Medicine (11th edition)., pp. 1717 - 1752). New York: Appleton-Century-Croft.

Brook, Robert H. & Lohr, Kathleen N. (1985). Efficacy, effectiveness, variations, and quality: Boundary-crossing research. Medical Care, 23(5), 710-722.

Brown, W., Knight, J., Patel, K., & Pilant, D. (1987). Is Nursing a Profession? Evaluation and the Health Profession? **10**(2), 206-226.

Bryant, Coralie & White, Louise, G. (1982). Project design and implementation. Managing Development in the Third World (pp. 107-134). Boulder, Colorado: Westview Press.

Burt, B. (1983a). Dental personnel in the United States. In D. Striffler, W. Young, & B. Burt (Eds.), Dentistry, Dental Practice, and the Community (3rd ed.) (pp. 421-465). Philadelphia: W.B. Saunders Co.

Burt, B. (1983b). The provision of dental care. In D. Striffler, W. Young, & B. Burt (Eds.), Dentistry, Dental Practice, and the Community (3rd ed.) (pp. 340-377). Philadelphia: W.B. Saunders Co.

Cain, G. G. & Robinson, G. H. (1969). Evaluating manpower programs for the disadvantaged. In G.G. Somers & W.D. Wood (Eds.), Cost-Benefit Analysis of Manpower Policies, Proceedings of a North American Conference May 14-15, 1969 (pp. 119-151). Published jointly by the Industrial Relations Centre, Queen's University, Kingston, Ontario, and the Center for Studies in Vocational and Technical Education, The University of Wisconsin, Madison, Wisconson.

Campen, J. T. (1986). Benefit, Cost, and Beyond. Cambridge, Mass: Ballinger Publishing Company.

Canadian Dental Association (1965). Appendix A: Relative value method of fee determination. Report of the Dental Services Committee. Transactions.

Canadian Dental Association (1980). Dental Health of Canadians: A Perspective. Ottawa: Canadian Dental Association.

Caplan, E. H. & Landekich, Stephen, (1974). Human Resources Accounting: Past, Present, and Future. New York: National Association of Accountants.

Carnevale, A. P. & Schulz, E. R. (1990). Return on investment: Account for training. Training and Development, **44**(Suppl. 7), S1-S32.

Chamberlain, N. W. (1969). Some further thoughts on the concept of human capital. In G. G. Somers & W.D. Woods (Eds.), Cost-Benefit Analysis of Manpower Policies (pp. 230-248). Kingston: Queen's University Press.

Chebib, F. S. (1973). Dentists in Canada. Winnipeg: University of Manitoba, Faculty of Dentistry.

Chorny, A. (1973). Mathematical models and health manpower. Proceedings from the Pan American Conference on Health Planning: Volume 2 - Methodologies and Information Systems (pp. 1-46). Washington: Pan American Health Organization.

Cohen, L. K. (1976). How the study was designed. International Dental Journal, **26**, 293-298.

Cohen, L. & Manion, L. (1980). Research Methods in Education. London: Croom Helm.

Cohen, S. I. (1985). A cost-benefit analysis of industrial training. Economics of Education Review, **4**, 327-340.

Cohn, E. (1979). The Economics of Education. Cambridge, Mass: Ballinger Publishing Co.

Corbett, T. C. (1979). The impact of continuing medical education on quality of care: Implications of the evaluation literature. In P.P. LeBreton, V. Bryant, D. Zawizig, D. Middaugh, A Bryant, & T.C. Corbett (Eds.), The Evaluation of Continuing Education for Professionals: A Systems Review. (pp. 369-393). Seattle: University of Washington, Division of Academic and Professional Programs, Continuing Education..

Cousins, N. (1979). The fallacy of cost-benefit ratio. Saturday Review, **6**, p. 8.

Crawford, P. R. & Holmes, B. W. (1989). An Assessment and Evaluation of Dental Treatment in Baffin Region. Unpublished study.

Creese, Andrew (1986). Cost-effectiveness of potential immunization interventions against diarrhoeal disease. Social Science and Medicine, **23**(3), 231-240.

Critical Care, (1988, May). Health Care. **30**(4), p. 19.

Culyer, A. J., Wiseman, J. Walker, R. (1977). An Annotated Bibliography of Health Economics: English Language Sources. London, England: Martin Robertson.

Davis, J. R. & Morrall, J. F. (1974). Evaluating Educational Investment. Lexington, Mass: Lexington Books.

Deets, C. & Blume, D. (1977). Evaluating the effectiveness of continuing education offerings. The Journal of Continuing Education in Nursing, **8**(3), 63-71.

De Jung, N. & Dunning, J. (1970). Methods for evaluating the quality of programs of dental care. Journal of Public Health Dentistry, **30**(4), 223-227.

del Bueno, D. J. (1977). Continuing education: spinach and other good things. Journal of Nursing Administration, 7(4), 32-34.

Dick, W. & Carey, L. (1985). The Systematic Design of Instruction. Glenview, Ill: Scott, Foresman & Company.

Dillard, Jesse F. (1982). Human resource accounting. In W.O. Cleverley (Ed.), Handbook on Health Care Accounting and Finance: Volume I (pp. 223-236). Rockville, Maryland: Aspen Publishers, Inc.

Dinkel, R. H. (1985). Cost benefit analysis: a helpful tool for decision makers? Health Policy, 4, 321-330.

Djukanovic, V. & Mach, E. P. (1975). Alternative Approaches to Meeting Basic Health Needs in Developing Countries (A joint UNICEF/WHO study). Geneva: World Health Organization.

Donabedian, A. (1969). A Guide to Medical Care Administration: Medical Appraisal - Quality and Utilization Volume 2. New York: American Public Health Association.

Drucker, P. F. (1985, March 26). A growing mismatch of jobs and job seekers. The Wall Street Journal.

Drummond, M. F. (1985). Survey of cost-effectiveness and cost-benefit analyses in industralized countries. World Health Statistics Quarterly, **38**, 4, 383-401.

Drummond, M. F. & Stoddart, G. L. (1985). Principles of economic evaluation of health programmes. World Health Statistics Quarterly, **38**, 4, 355-367.

Drummond, M. F., Stoddart, G. L. & Torrance, G. W. (1987). Methods for the Economic Evaluation of Health Care Programmes. Oxford, England: Oxford University Press.

Dunlop, D. W. (1975). Benefit-cost analysis: A review of its applicability in policy analysis for delivering health services. Social Science and Medicine, **19**, 133-139.

Dunning, J. M. (1979). Evaluating the quality of dental care. Principles of Public Health Dentistry. Cambridge, Mass: Harvard University Press.

Dunning, J.M. (1986). Principles of Dental Public Health (4th ed.). Cambridge, Mass: Harvard University Press.

Dymond, W. R. (1969). The role of benefit/cost analysis in formulating manpower policy. In G. Somers and W. Wood (Eds.), Cost-Benefit Analysis of Manpower Policies, Proccedings of a Northern American Conference, May 14-15, 1969 (pp. 42-55). Kingston, Ontario: Queen's University Industrial Relations Centre.

Elderton, R. (1974). Dental ancillaries. In G. Slack & B. Burt (Eds.), Dental Public Health: An Introduction to Community Dentistry (pp. 202-220). Bristol, England: John Wright & Sons.

Fairbank, A. W. (1980). Benefit-cost analysis for health and development programming: Considerations for Practical Applications. International Health: Measuring Progress. Washington, D.C.: National Council for International Health.

Fisher, Morton A. (1971). Quality controls. New York State Dental Journal, 37(1), 21-27.

Fitz-Gibbon, C. & Morris, L. (1978). How to Calculate Statistics. Beverly Hills: California, Sage Publications.

Flahault, D. & Roemer, M. (1986). Leadership for Primary Health Care (Public Health Papers 82). Geneva: World Health Organization.

Flamholtz, Eric (1978). Human resources accounting. In S. Davidson & R. Weil (Eds.), Handbook of Cost Accounting. New York: McGraw-Hill.

Forni, P. R. (1975). Continuing education vs. continuing competency. Journal of Nursing Administration. 5(9), 34-38.

Fowler, M. & Hunt, A. (1976). A Study of Dental Manpower Systems in Relation to Oral Health Status - Part I - Ontario. Toronto: University of Toronto, Faculty of Dentistry.

Gagne, R., Briggs, L., & Wager, W. (1988). Principles of Instructional Design (3rd ed.). New York: Holt, Rinehart, and Winston, Inc.

Garbutt, Douglas, (1969). Training Costs. London: Gee & Co (Publishers) Ltd.

Gerber, M. (1981). Selection of primary health care workers in East Africa: A comparative study. The Training and Support of Primary Health Care Workers. Washington, D.C.: National Council for International Health.

Gilson, Lucy (1990). National community health worker programmes. World Health Forum, **11**(1), 85-86.

Glenn, N. D. (1977). Cohort Analysis. Beverly Hills: Sage Publications.

Green, L., Kreuter, M., Deeds, S., & Partridge, K. (1980). Health Education Planning: A Diagnostic Approach. Palo Alto, CA: Mayfield Publishing.

Green, L. & Lewis, F. (1986). Measurement and Evaluation in Health Education and Health Promotion. Palo Alto, CA: Mayfield Publishing.

Griffiths, A. (1988). Cost-effectiveness and cost-benefit analysis of health services: the methodology and its application. Health Policy, **9**, 251-265.

Griffiths, A. et al. (1980). An Annotated Bibliography of Health Economics: Western European Sources. Oxford, England: Martin Robertson.

Guilbert, J.-J. (1981). Educational Handbook for Health Personnel (Offset Publication No. 35). Geneva: World Health Organization.

Habicht, J. P. (1979). Assurance of quality in the provision of primary medical care by non-professionals. Social Science and Medicine, **13B**, 1367-1375.

Haggart, S. A. (1972). Program Budgeting for School District Planning. Englewood Cliffs, NJ: Educational Technology Publications, 1972.

Hall, T. (1978). Demand. In T. Hall & A. Mejia (Eds.), Health Manpower Planning: Principles, Methods, Issues (pp. 57-90). Geneva: World Health Organization.

Hall, T. & Mejia, A. (Eds.). (1978). Health Manpower Planning: Principles, Methods, Issues. Geneva: World Health Organization.

Hammons, P. E., Jamison, H. C., & Wilson, L L. (1971). Quality of service provided by dental therapists in an experimental program at the University of Alabama. Journal of the American Dental Association, **82**(5), 1060-1066.

Hawthorne, E. (1987). Evaluating Employee TrainingnPrograms:A Research-Based Guide for Human Resources Managers. New York: Quorum Books.

Head, Glenn E. (1985). Training Cost Analysis: A Practical Guide. Washington, DC: Marlin Press.

Head, Glenn E. & Buchanan, Charles C. (1981). Cost/benefit analysis of training: A foundation for change. NSPI Journal, **20**(10), 25-27.

Health and Welfare Canada, (1984). Community Health Representative Program Evaluation Study Volume I. Ottawa: Medical Services Branch.

Health and Welfare Canada (1987). An Analysis of Dental Health Services in the NWT and Yukon Between 1983 and 1986. (A Technical Report prepared as part of the Evaluation of the Northern Health Services Program). Unpublished Report. Ottawa: Health and Welfare Canada, Program Audit and Review Directorate.

Health and Welfare Canada, (1989). Health and Welfare Canada1989-1990 Estimates, Part III: Expenditure Plan (Supply and Services Canada Catalogue No. BT31-2/1990-III-29). Ottawa: Canadian Government Publishing Centre.

Health and Welfare Canada (1990). Health Personnel in Canada - 1988. Ottawa: Canadian Government Publishing Centre.

Health and Welfare Canada, (1991). Health and Welfare Canada 1991-1992 Estimates, Part III: Expenditure Plan (Supply and Services Canada Catalogue No. BT31-2/1992-III-29). Ottawa: Canadian Government Publishing Centre.

Heller, P. S. (1981). The cost and financing of PHCW training scheme: Some initial thoughts. The Training and Support of Primary Health Care Workers. Washington, D.C.: National Council for International Health.

Hord, A. B., Thompson, G. W., Ellis, R. L. (1974). The Ontario Dental Association demonstration project on dental auxiliaries with expanded duties. Ontario Dentist, **51**(6), 14-18.

Horowitz, H. S. & Heifetz, S. B. (1979). Methods for assessing the cost-effectiveness of caries preventive agents and procedures. International Dental Journal, **29**(2), 106-117.

House, R. (1970). Dentistry in Ontario: A Study for the Committee of the Healing Arts. Toronto: Queen's Printer.

Hu, T. (1976). The financing and the economic efficiency of rural health services in the People's Republic of China. Internation Journal of Health Services, 6(2), 239-249.

Huenemann, Ralph W. (1989). A persistent error in cost-benefit analysis: the case of the Three Gorges Dam in Canada. Energy Systems and Policy, **13**, 157-168.

Indian and Northern Affairs Canada, (1990). Basic Departmental Data, 1990. (Catalogue No.: R-12-7/1990E). Ottawa: Minister of Supply and Services Canada.

Issac, S. & Michael, W. B. (1981). Handbook in Education and Evaluation. San Diego, California: Edits Publishers.

Jameson, K. P. (1981). Implementing Benefit-cost analysis: Theory meets reality. Journal of Management Studies, **18**, 4, 411-422.

Joglekar, P. (1986). Cost-benefit studies of health care programs: Choosing methods for desired results. In S. Cordray and M. Lipsey (Eds.), Evaluation Studies Review Annual: Volume 11. Beverly Hills, CA: Sage Publications.

Johnson, Terry (1986). JTPA Evaluation at the State and Local Level. Volume VI: An Implementation Manual for Net Impact Evaluations. Olympia, WA: Washington State Department of Employment Security. (ERIC Document Reproduction Service No. ED 278 843.

Johnson, G. N. & Eady, C. M. (1972). How much does diploma nursing education really cost? Nursing Outlook, **20**, 658-664.

Kaufman, Roger (1988). Planning Educational Systems. Lancaster, Penn: Technomic Publishing Co., Inc.

Kaufamn, R. & Stone, B. (1983). Planning for Organizational Success. New York: John Wiley and Sons.

Kaufman, R. & Thiagarajan, S. (1987). Identifying and specifying requirements for instruction. In R. Gagne (Ed.), Instructional Technology Foundations (pp. 113-140). Hillsdale, NJ: Larwrence Erlbaum Associates.

Kearsley, Greg (1982). Costs, Benefits, and Productivity in Training Systems. Don Mills, Ontario: Addison-Wesley Publishing Co.

Kearsley, Greg (1986a). Analyzing the costs and benefits of training: Part 1 - An Introduction. Performance and Instruction Journal, February 1986, 30-32.

Kearsley, Greg (1986b). Analyzing the costs and benefits of training: Part 2 - Identifying costs and benefits. Performance and Instruction Journal, April 1986, 23-25.

Kearsley, Greg (1986c). Analyzing the costs and benefits of training: Part 3 - Formulating Models. Performance and Instruction Journal, May 1986, 13-16.

Kearsley, Greg (1986d). Analyzing the costs and benefits of training: Part 4 - Data Collection. Performance and Instruction Journal, July 1986, 8-10.

Kearsley, Greg (1986e). Analyzing the costs and benefits of training: Part 5 - Putting the results into action. Performance and Instruction Journal, August 1986, 8-9.

Keppel, G. & Saufley, W. (1980). Introduction to Design and Analysis: A Student's Handbook. New York: W. H. Freeman and Company.

Kerlinger, N. F. (1987). Foundations of Behavioral Research. Fourth Edition. New York: Holt, Rinehart and Winston.

Klarman, H. E. (1974). Application of cost-benefit analysis to the health services and the special case of technological innovation. International Journal of Health Services, 2, 325-352.

Kober, T. C. (1982). An Overview of Cost-Benefit Analysis for Educators of Health Care Providers. Cincinnati, Ohio: Cincinnati Technical College. (ERIC Document Reproduction Service No. ED 224 533).

Koehler J. E. & Slighton, R. L. (1973). Activity analysis and cost analysis in medical schools. Journal of Medical Education, **48**, 531-550.

Kushner, J. (1976). A benefit-cost analysis of nurse practitioner training. Canadian Journal of Public Health, **67**, 405-409.

Levin, H. (1975). Cost-effectiveness analysis in evaluation research. In M. Guttentag & E. Struening (Eds). Handbook of Evaluation Research. Vol. 2, 89-122, Beverley Hills, Ca: Sage Publications.

Lloyd, J. S, & Abrahamson, S. (1979). Effectiveness of continuing medical education: A review of the evidence. Evaluation and the Health Professions, **2**(3), 251-280.

Martin, G. L., Newman, I. M. (1973). Cost and effects of a student health aide programme. Journal of the American College Health Association, **21**, 233-240.

Mathias, R. L. & Jackson, J. H. (1982). Personnel: Contemporary Perspectives and Applications. St. Paul, Minn.: West Publishing Company.

McBride, M., Bertrand, J., Santiso, R., & Fernandez, V. (1987). Cost effectiveness of the APROFAM program for voluntary surgical contraception in Guatamela. Evaluation Review, **11**, 3, 300-326.

McFarlane, B. (1964). Dental Manpower in Canada. Royal Commission on Health Services. Ottawa: Queen's Printer.

McMillan, J. & Schumacher, S. (1984). Research in Education: A Conceptual Introduction. Boston: Little, Brown and Co.

Mejia, A. (1980). World trends in health manpower development. World Health Statistics Quarterly, **33**(2), 112-126.

Mills, Anne (1985a). Economic evaluation of health programmes:Application of the principles in developing countries. World Health Statistics Quarterly, **38**, 4, 368-382.

Mills, Anne (1985b). Survey and examples of economic evaluation of health programmes in developing countries. World Health Statistics Quarterly, **38**, 4, 402-430.

Mills, Anne, & Drummond, M. F. (1985). Economic evaluation of health programmes: Glossry of terms. World Health Statistics Quarterly, **38**, 4, 432-434.

Mills, Anne, & Thomas, Margaret, 1984. Economic Evaluation of Health Programmes in Developing Countries (EPC Publication No. 3). London, England: London School of Hygiene and Tropical Medicine, The Evaluation and Planning Centre.

National School of Dental Therapy, (1989). Canadian Dental Therapist: A Health Career. Prince Albert, Sask: National School of Dental Therapy.

National School of Dental Therapy, (1990). Explanation of Dental Therapy Services Summary and Productivity Analysis. Prince Albert, Sask: National School of Dental Therapy.

Niessen, L. C. & Douglass, C. W. (1984). Theoretical Considerations in Applying Benefit-Cost and Cost-Effectiveness Analyses to Preventive Dental Programs. Journal of Public Health Dentistry, **44**(4), 156-165.

Oliver, S. K. (1984). The effects of continuing education on the clinical behaviour of nurses. Journal of Continuing Education in Nursing, **15**(4), 130-134.

Parnes, H. S. (1984). Peoplepower: Elements of Human Resource Policy. Beverly Hills: Sage Publications.

Pelton, W., Embry, O., Overstreet, G., & Dilworth, J. (1973). Economic implications of adding two expanded-duty dental assistants to a practice. Journal of the American Dental Association, **87**, 604-609.

Petrikowski, C. Grace (1988). Dental therapists in Canada: A revolution in Dental Care for Natives. Bulletin of the History of Dentistry, **36**(2), 97-104.

Popham, W. J. (1988). Educational Evaluation. Englewood Cliffs, N.J.: Prentice Hall.

Popkin, B. M., Solon, F. S., Fernandez, T., & Latham, M. C. (1980). Benefit-cost analysis in the nutrition area: A project in the Philippines. Social Science and Medicine, **14C**, 207-216.

Prest, A. R., & Turvey, R. (1965). Cost-benefit analysis: A survey. The Economic Journal., **75**, 683-735.

Quade, E. S. (1967). Cost-effectiveness analysis: An introduction and overview. In T. Goldman (Ed.). Cost-Effectiveness mAnalysis: New Approaches in Decision-making. New York: Praeger Publishers.

Ray, Anandarup (1984). Cost-Benefit Analysis: Issues and Methodologies. Baltimore: Johns Hopkins University Press.

Ray, D. (1983). A conceptual framework for health manpower planning. In C.A. Jaspers, A.R. Tarlov, & E.L. Vruland (Eds.), Health Manpower Planning. Boston: Martinus Nijhoff Publishers.

Reddy, Y. (1979). Cost-benefit analysis of training - an appraisal. Long Range Planning, **12**, 50-55.

Redig, D., Snyder, M., Nevitt, G., & Tocchini, J. (1974). Expanded duty dental auxiliaries in four private dental offices: the first year's experiene. Journal of the American Dental Association, **88**, 969-984.

Rees Allan M. & Jutai, David (1979). Management, Productivity and Cost Benefit of Graduate Dental Therapists for Years 1975-1979. Unpublished Manuscript.

Reynolds, J. (1986). An overview of operations research methods for improving management decision making in health and family planning. Management Issues in Health Programs in the Developing World. Washington, D.C.: National Council for International Health.

Rizzuto, Carmela (1982). Mandatory continuing education: cost versus benefit. Journal of Continuing Education in Nursing, **13**(3), 37-43.

Roder, D. M. (1978). The employment of dental nurses. Journal of Public Health Dentistry, **38**(2), 159-171.

Romcke, R. & Lewis, D. W. (1973). Use of expanded function dental hygienists in the Prince Edward Island dental manpower study. Journal of the Canadian Dental Association, **4**, 247-262.

Romiszowski, A. J. (19881). Designing Instructional Systems. New York: Nichols Publishing Co.

Rosenblum, F. N. (1971). Experimental auxiliary training program. Journal of the American Dental Association, **82**, 1082-1089.

Rothenberg, Jerome (1975). Cost-benefit analysis: A methodological exposit')n. In M. Guttentag & E. Struening (Eds.), Handbook of Education Research: Volume Two (pp 55-88). Beverly Hills, California: Sage Publications.

Rowntree, D. (1981). Statistics without Tears: A Primer for Non-mathematicians. London: Penguin Books.

Ryge, G. & Snyder, M. (1973). Evaluating the clinical quality of restorations. Journal of the American Dental Association. **8**, 369-377.

Sackett, D. (1980). Evaluation of Health Services. In J. Last (Ed.), Maxcy-Rosenau Public Health and Preventive Medicine (11th ed., pp. 1800-1823). New York: Appleton-Century- Crofts.

Schaefer, M. & Pizurki, P. (1984). Human resourses for health for all. World Health Statistics Quarterly, **37**(1), 52-83.

Schonfeld, H. (1974). Evaluation of the quality of oral care systems. In. W. Brown (Ed.), Oral Health, Dentistry, and the American Public (pp. 229-286). Norman, Oklahoma: University of Oklahoma Press.

Smith, K. A. (1987). Educational engineering: Heuristics for improving learning effectiveness and efficiency. Engineering Education, **78**(1), 274-279.

Soricelli, D. (1971). Practial experience in peer review controlling quality of delivery of dental care. American Journal of Public Health, **61**(10), 2046-2056.

Soricelli, D. (1972). Implementation of the Delivery of Dental Services by Auxiliaries - The Philadelphia Experience. American Journal of Public Health, **62**(8), 1077-1087.

Sparks, P. (1985). A systematic budget process for continuing education programs. In A. Adelson, F. Watkins, & R. Caplan (Eds.), Continuing Education for the Health Professionals: Educational and Administrative Methods (pp. 119-140). Rockville, Maryland: Aspen Systems Corporation.

Spencer, Lyle M. (1984). How to calculate the costs and benefits of an HRD program. Training, July 1984, 40-51.

Spitzer, W. O., Roberts, R. S. & Delmore, T. (1976). Nurse practitioners in primary care: V. Development of the utilization and financial index to measure effects of their development. Canadian Medical Association Jounral, **114**, 1099-1102.

Stewart, Miriam J. (1990). Access to Health Care for Economically Disadvantaged Canadians: A Model. Canadian Journal of Public Health, **81**(6), 450-455.

Storms, D. M. (1979). Training and Use of Auxiliary Health Workers: Lessons from Developing Countries (American Public Health Association International Health Programs Monograph Series No. 3). Washington, D.C.: American Public Health Association.

Stromsdorfer, E. & Blalock, Ann, B. (1986). JTPA Evaluation at the State and Local Level. Volume VII: Issues Related to Net Impact Evaluations. A. Issues in Evaluating Costs and Benefits. B. The Debate Over Eperimental vs. Quasi-Experimental Approaches. Olympia, Washington: Washington State Department of Employment Security. (ERIC Document Reproduction Service No. ED 278 844)

Suver. James D. (1982). Zero base budgeting. In W. O. Cleverley (Ed.), Handbook of Health Care Accounting and Finance: Volume I (pp. 253-276). Rockville, Maryland: Aspen Publishers, Inc.

Swanson, Richard A. & Geroy, G. D. (1984). Forecasting the Economic Benefits of Training. Training and Development Research Centre: Project Number One. St. Paul, Minn: Department of Vocational and Technical Education, University of Minnesota,. (ERIC Document Reproduction Service No. ED 260 215).

Talbot, J. R. & Ellis, C. C. (1969). Analysis and Cost of Company Training. London: Gower Press Limited.

Thompson, Mark S. & Fortess Eric (1980). Cost-effectiveness in health program evaluation. Evaluation Review, 4(4), 549-568.

Torbert, Kenneth W. (1990). Dental therapists in Canada 1990. Canadian Journal of Public Health Dentistry.

Tosti, D. J. (1980). How to waste your training dollars. Administrative Management, **41**(2), 44-50.

Turner, Phyllis (1986). Benefits and Costs of Continuing Nursing Education: An Analytical Survey. Unpublished doctoral dissertation, University of Virginia.

Young, W. (1983). The social setting of dental health practice. In D. Striffler, W. Young, & B. Burt (Eds.), Dentistry, Dental Practice, and the Community, Philadelphia: W.B. Saunders Co.

Treasury Board, (1982). Benefit-Cost Analysis Guide (Supply and Services Canada Publication No. BT 35-2-1976E). Ottawa, Canada: Canadian Government Printing Office.

Waldman, H. B. & Marinelli, R. D. (1985). The worldwide growth of dental auxiliary personnel. The Dental Assistant, September October 1985, 23-25.

Walsh, J. & Warren K. (1979). Selective primary health care: An interim strategy for disease control in developing countries. New England Journal of Medicine, **301**(18), 967-974.

Wang'ombe, J. K. (1984). Economic evaluation in primary health care: the case of western Kenya community based health care project. Social Science and Medicine, **18**(5), 375-385.

Warner, K. E. (1989). Issues in cost effectiveness in health care. Journal of Public Health Dentistry, **49**(5), 272-278.

Warner, K. E. & Hutton, R. C. (1980). Cost-benefit and cost-effectiveness analysis in health care: Growth and composition of the literature. Medical Care, **18**(11), 1069-1084.

Warner, K. E. & Luce, B. R. (1982). Cost-Benefit and Cost Effectiveness Analysis in Health Care: Principles,Practice,and Potential. Ann Arbor, Mich: Health Administration Press.

Weinstein, M. C. & Stason, W. B. (1977). Foundations of cost-effectiveness analysis for health and medical practices. New England Journal of Medicine, **296**(13), 716-721.

White, R. N., Weidman, J. C., Sharp, L. M. (1983). Assessment of a Win Quality Training Demonstration Program. (Report No. BSSR-0595-11). Washington: Bureau of Social Science Research. (ERIC Document Reproduction Service No. ED 266 306).

Williams, A. (1973). Cost-benefit analysis: Bastard science and/or insidious poison in the body politick? In J. Wolf (Ed.). Cost Benefit and Cost Effectiveness: Studies and Analysis. London: George Allen & Unwin Ltd.

Wood, Christoper (1981). The selection, training and support of primary health care workers. The Training and Support of Primary Health Care Workers. Washington, D.C.: National Council for International Health.

Wood, W. D. & Campbell, H. F. (1970). Cost-Benefit Analysis and the Economics of Investment in Human Resources: An Annotated Bibliography. Kingston, Ontario: Industrial Relations Centre, Queen's University.

World Health Organization (1977). World Directory of Schools for Dental Auxiliaries: 1973. Geneva: World Health Organization.

World Health Organization (1978). Measurement of Coverage, Effectivenss, and Efficiency of Different Patterns of Health Care. (Document SHS/78/1). Geneva: World Health Organization.

World Health Organization (1979). Training and Utilization of Auxiliary Personnel for Rural Health Teams in Developing Countries (Technical Report Series 633). Geneva: World Health Organization.

World Health Organization (1989). World Health Statistics Annual-1988. Geneva: World Health Organization.

World Health Organization/UNICEF, (1978). Proceedings of the International Conference on Primary Health Care, Alma-Ata, U.S.S.R., 6-12 September 1978. Geneva: World Health Organization.

Worrall, John D. (1977). A benefit-cost analysis of the vocational rehabilitation program. The Journal of Human Resources.

Wray, Joe (1973). Health Care and the Community: A View of Southeast Asia. Paper presented at the Seminar on Building Health Through Community Participation and Paramedical Training, Davao, Philippines.

Yates, Brian T. (1986). Cost-effectiveness analysis and cost-benefit analysis: an introduction. In D. Cordray & M. Libsey (Eds.). Evaluation Studies Review Annual: Volume 11. Beverly Hills: Sage Publications.

Young, W. O. (1983). The social setting of dental health practice. In D. Striffler, W. Young, & B. Burt (Eds.), Dentistry, Dental Practice, and the Comunity (3rd ed.). Philadelphia: W.B. Slaunders Company.

Ziderman, Adrian (1978). Manpower Training: Theory and Policy. London, England: The Macmillan Press Ltd.

Zöllner, H. F. K. (1985). Introduction. World Health Statistics Quarterly, 38, 4, 351-354.

APPENDIX A

COVER AND FOLLOW-UP LETTERS

315 Champlain Avenue
Sydney, Nova Scotia
B1P 2B9

May 17, 1991

Dear

Please accept this letter as a personal request from me as President of the Canadian Dental Therapists Society.

Gordon Trueblood is conducting a research survey on the costs and benefits of training and employing dental therapists to work in Indian and northern communities. The information you provide will help to provide a much clearer understanding of how the dental therapy program operates in achieving its objectives. I have had an opportunity to personally discuss the study with Gordon. I think one of the most important outcomes of the study is that it will provide an opportunity for recognition which the dental therapists so richly deserve.

Please take a few minutes to complete the enclosed questionnaire. Place the questionnaire in the enclosed, self-addressed, and postage paid envelope and return it. When the study is completed, the results will be made available to all dental therapists.

Your response will be kept confidential and your name and the names of the communities which you serve will not appear in any reports.

I sincerely appreciate your cooperation in this study.

Yours truly,

Maureen Connors
President
Canadian Dental Therapists Society

Health and Welfare Canada
Santé et Bien-être social Canada

Room 1197, 1195
Jeanne Mance Building
Tunney's Pasture
Ottawa, Ontario
K1A 0L3

Your file / Votre référence

Our file / Notre référence

May 17, 1991

Dear

We are requesting your participation in a research project designed to provide a better understanding of how the dental therapy program operates and to provide Health and Welfare Canada with information needed for assessing priorities for resources to be allocated to the dental therapy program. Specifically, we would like to ask you for your cooperation to complete the enclosed questionnaire, a task that is anticipated to take no more than 15 minutes of your time.

You are one of only 75 dental therapists currently working in Indian and northern communities. Therefore, the information you provide will be very important in helping us to meet the objectives of the study. The questionnaire is being sent to you because we believe dental therapists' views and opinions should be taken into account in trying to develop a better understanding of how the program operates.

Please answer all of the questions in the questionnaire. Then return it in the enclosed postage-paid envelope as soon as possible within the next two weeks. We would like to have all questionnaires returned no later than June 30, 1991.

All of your responses will be kept confidential. The identification number on the covering page of the questionnaire is for mailing purposes only. When the questionnaire is returned, the front page will be removed and the number will be checked off the mailing list. The questionnaire responses can then be entered anonymously into the computer.

We hope you will find the questionnaire interesting. Thank you for your cooperation.

Sincerely yours,

W. R. Bedford, DDS, DDPH
Senior Consultant, Dentistry
Medical Services Branch

Gordon Trueblood, BScPH, MPH
Researcher
Medical Services Branch

Canada

Health and Welfare Canada
Sante et Bien-etre social Canada

Medical Services Branch
Room 1195
Jeanne Mance Building
Tunney's Pasture
Ottawa, Ontario
K1A 0L3

July 10, 1991

Dear

Recently we wrote to you and requested that you complete and return a survey form regarding the dental therapy program.

Most dental therapists have responded. However, in order to make the study as valid as possible, we are most anxious to obtain responses from all dental therapists. As of today, we have not received your completed survey form.

For your convenience, enclosed is another copy of the survey form along with a prepaid, self-addressed return envelope. If you have not already done so, would you please fill in the form and return it to us as soon as possible. Your opinions are important to this study.

Thank you for your cooperation and help in this study.

Sincerely,

Gordon Trueblood
Medical Services Branch

Canada

APPENDIX B

SURVEY QUESTIONNAIRE

SURVEY OF DENTAL THERAPIST GRADUATES IN EMPLOYMENT

The purpose of this survey is to obtain your views and experiences as a dental therapist. Your responses will be treated confidentially. Only totals and percentages will be reported.

BACKGROUND INFORMATION

1. **What is your sex?**

   Circle one number only

   A. Male. 1

   B. Female. 2

2. **In what age group would you classify yourself?**

   Circle one number only

   A. 20 - 24 1

   B. 25 - 29 2

   C. 30 - 34 3

   D. 35 - 39 4

   E. 40 - 44 5

   F. 45 - 49 6

   G. 50 - 54 7

   H. 55 and over 8

3. **Are you a member of one of the Aboriginal peoples of Canada?**

   Circle one number only

   A. No → If no, go to question 4 1

   B. Yes → If yes, go to question 3b on the next page 2

Please continue to the next page . . ./

3b. **If yes, please circle the group in which you are a member.**

Circle one number only

A. Indian (status or non-status) 1

B. Metis 2

C. Inuit 3

4. **In what region or territory do you work?**

Circle one number only

A. Atlantic Region (New Brunswick, Prince Edward Island, Nova Scotia Newfoundland - Labrador 1

B. Manitoba Region 2

C. Saskatchewan Region 3

D. Alberta Region 4

E. Pacific Region (British Columbia) 5

F. Yukon Territory 6

G. Northwest Territories 7

5. **How would you classify the community in which you live (i.e. where your residence is located)?**

Circle only one number

A. Urban - Refers to a community located within 50 miles of an urban centre. i.e., a centre of 10,000 persons or over, not necessarily Indian or Inuit . . 1

B. Rural - Refers to a community that has reasonable means of transportation (one road at least), and is located more than 40 miles from an urban centre. . . 2

C. Remote -(Also classified as isolated). Refers to communities lacking reasonable means of transportation. i.e. the community is not accessible by road 3

Please continue to the next page . . ./

6. **During the six months immediately prior to enroling at the National School of Dental Therapy, what did you do?**

Please circle no more than two numbers

A. Full-time student 1

B. Part-time student 2

C. Employed full-time (30 hours a week or more) 3

D. Employed part-time (less than 30 hours a week) 4

E. Unemployed, seeking work 5

F. Unemployed, not seeking work 6

7. **What is the highest level of education you have attained not including your qualifications as a dental therapist?**

Please circle only one number, the one which best applies to you

A. High school: Incomplete 1

Completed 2

B. Community college, vocational school, or Institute of technology: Incomplete 3

Completed 4

C. College or University: Incomplete 5

Completed 6

Please continue to the next page . . ./

8. **Since becoming a graduate Dental Therapist, how many actual years have you worked as a dental therapist? (Do not include time when you were on extended leave such as leave without pay, maternity leave, temporarily layed off, working for another employer, etc.)**

Circle one number only

A. Less than one year 1

B. 1 - 2 years 2

C. 3 - 4 years 3

D. 5 - 6 years 4

E. 7 years or more 5

9. **In looking at the availability of the instruments, supplies, and equipment you need to do your job, which of the following statements best describes your present situation?**

Circle one number only

A. I never have the appropriate instruments, supplies and equipment I need to do my job . . 1

B. I seldom have the appropriate instruments, supplies and equipment I need to do my job . . 2

C. I almost always have the appropriate instruments, supplies and equipment I need to do my job . . 3

D. I always have the appropriate instruments, supplies and equipment I need to do my job . . 4

Please continue to the next page..../

10. **In the past 24 months, have you participated in any continuing education activity such as a refresher course, in-service education, community college or university courses, correspondence course, etc.?**

Circle one number only

A. No → If no, go to question 11. 1

B. Yes → If yes, go to question 10b. 2

10b. **If yes, below are three phrases that might be used to describe the benefits of continuing education activities. For <u>each</u> of the three phrases, circle one number that best describes the degree to which you benefited from attendance or participation in the continuing education activity. If you have participated in more than one activity or event, in general, how have these activities benefited you?**

Circle one number per line

My continuing education activity:

	No Benefit	Small Benefit	Moderate Benefit	Large Benefit
A. Improved my job motivation	1	2	3	4
B. Helped to improve my job performance	1	2	3	4
C. Helped me to acquire new job skills	1	2	3	4
D. Other benefit to you (specify & circle the degree of benefit)				
_____	1	2	3	4
_____	1	2	3	4

Please continue to the next page . . ./

11. **The reasons for your decision to become a dental therapist.**

How important were each of the following factors to you when deciding to become a dental therapist? (For <u>each</u> statement please circle one number that best describes the importance that factor was to you).

<u>Please circle one number per line</u>

	Not Important	Little Importance	Moderate Importance	Very Important
A. Type of Work	1	2	3	4
B. Job security	1	2	3	4
C. Salary level	1	2	3	4
D. Good career prospect .	1	2	3	4
E. Opportunity to acquire vocational skills . .	1	2	3	4
F. Geographical location of dental therapist jobs.	1	2	3	4
G. Doing a socially "useful" job	1	2	3	4
H. High level of responsibility.	1	2	3	4
I. Training Costs paid by Federal Government . .	1	2	3	4
J. Pleasant working conditions	1	2	3	4
K. Variety in work . . .	1	2	3	4
L. Other (please specify and circle its importance)				
_____	1	2	3	4
_____	1	2	3	4

Please continue to the next page . . ./

12. More about your present job as a dental therapist

(a) How does your work as a dental therapist compare with your expectations when you first became a dental therapist -- in terms of the following job attributes (For each statement please circle one number that best describes your expectations.)

Circle one number per line

	Worse Than Expected	Same as Expected	Better Than Expected
A. Job security	1	2	3
B. Salary level	1	2	3
C. Good career prospects	1	2	3
D. Using your skills and abilities to the fullest	1	2	3
E. Opportunities for further training	1	2	3
F. Geographical location of dental therapist jobs.	1	2	3
G. Doing a socially "useful" job	1	2	3
H. High level of responsibility . .	1	2	3
I. Pleasant working conditions . .	1	2	3
J. Variety in work	1	2	3

(b) Are there other ways which you consider your present employment differs from what you expected?

_____	1	2	3
_____	1	2	3

Please continue to the next page..../

13. **Future job change**

How likely is it that you will be working as a dental therapist in Indian or northern communities in two years time?

Circle one number only

A. Very likely 4

B. Quite likely 3

C. Not very likely 2

D. Not at all likely 1

14. **Which factors affected your response to question #13?**

Circle no more than three numbers

A. Job security 1

B. Salary level 2

C. Probability of transfer of health services to band control 3

D. Probability of change in marital status 4

E. Location of the job 5

F. Plan to pursue further education 6

G. Other (please specify)

_____

_____

_____

Please continue to the next page . . ./

15. **Job Satisfaction**

How satisfied are you with your work as a dental therapist? (For each item below please circle one number that best describes your satisfaction according to the following scale):

Circle one number per line

How satisfied are you with:

	Dissatisfied	Not very Satisfied	Quite Satisfied	Very Satisfied
A. Your job in general	1	2	3	4
B. Your pay	1	2	3	4
C. The number of hours you work	1	2	3	4
D. The schedule of your working hours	1	2	3	4
E. The sorts of things you do on the job	1	2	3	4

16. What do you consider the best aspects of your job?

List in order of importance

(1)_____

(2)_____

(3)_____

17. What do you consider the worst aspects of your job?

List in order of importance

(1)_____

(2)_____

(3)_____

Thank you for completing this questionnaire. Please return it in the self-addressed prepaid envelope.

APPENDIX C

BENEFITS OF CONTINUING EDUCATION

Benefits of Continuing Education

No Benefit 1	Small Benefit 2	Moderate Benefit 3	Large Benefit 4

Benefit	Average Rating
Improved my job motivation	3.06
Helped me to improve my job performance	2.96
Helped me to acquire new job skills	2.79

Other Benefits of Continuing Education

Benefit	Rating
Improved my morale	4
Gave me a mid-winter break which I needed	4
Satisfaction of learning	4
Developed a broader view of health care	4
Level of patient care	4
Keep CPR current	4
Increase job prospects after takeover	4
Helped me understand policies of G.N.W.T.	4
Helped me get to know other Dental Therapists	4
Compare my experiences with others	4
Interaction with other therapists	4
Made me aware of Dental Therapist having similar problems	4
Increased awareness of how other Dental Therapists were handling similar problems	4
Share information with other Dental Therapists	4
Put me in touch with others with similar concerns	4

Benefit	Rating
Meet and learn from other dental therapists	4
Meet and talk with other dental therapists	3
Meet other therapists and Dental Officer-in-charge	3
Chance to share ideas	3
Update on new techniques/practices (i.e., equipment and infection control)	3
CPR certification	2
Working with and managing problem children	2
Results-resolution of common problems	-

APPENDIX D

REASONS FOR BECOMING A DENTAL THERAPIST

Reasons for Becoming a Dental Therapist

Not Important 1	Little Important 2	Moderate Important 3	Very Important 4

Reason	Average Rating
Type of work	3.60
Doing a socially "useful" job	3.51
High level of responsibility	3.41
Job security	3.39
Good career opportunity	3.31
Variety in work	3.28
Salary level	3.23
Opportunity to acquire vocational skills	3.13
Pleasant Working conditions	3.13
Training costs paid by federal government	2.92
Geographical location of dental therapist jobs	2.63

Other Reasons for Becoming a Dental Therapist

Reason	Rating
To be an example to my native population especially at home	4
Opportunity to help my native population to experience better health	4
Role model for my community	4
A way to help my own people	4
Being a role model for other native people	4
Future of the job	4
Job recognition	4

Reason	Rating
Fulfilment of childhood dream	4
Desire to learn all disciplines within the field of dental work	4
Work with children	4
Somewhat independent (no supervisor behind my back)	4
Career advancement	4
Length of training	4
Challenge of work	4
Working for the government	4
Wanted to experience the arctic	4
Job independence	4
Employee/employer relations	4
Spouse was already a dental therapy student	4
Provided training for volunteer activities in developing countries	4
Helping others in need	4
Past history of dental experience	4
Learning a new culture and language	3
Social status	3

APPENDIX E

ABOUT YOUR PRESENT JOB AS DENTAL THERAPIST

How does your work as a dental therapist compare with your expectations when you first became a dental therapist?

Worse than Expected 1	Same as Expected 2	Better than Expected 3

Expectations	Average Rating
Salary level	2.40
Doing a "socially" useful job	2.34
High level of responsibility	2.33
Using my skills and abilities to the fullest	2.18
Variety in work	2.06
Pleasant working conditions	2.00
Geographical location of dental therapist jobs	1.89
Job security	1.84
Good career prospects	1.53
Opportunities for further training	1.37

Other expectations

Expectation	Rating
Personal growth and development directly related to work experience	3
Isolation post allowance, medical and dental benefits	3
Social status	3
Self worth	3
Job sharing with spouse	3
High personal control over tasks and operational organization	3
NSDT meddling	1
Isolation	1

Expectation	Rating
Number of VTA's per year	1
Number of travel days per year (with pay in association with VTA's)	1
Having to take leave without pay	1
Tooth decay rate in northern populations	1
Not working on adult patients	1
Loneliness, boredom, monotony	1
The large social conditions one must deal with	1
It is much more political than expected	1
Racism	1
Did not expect to be transferred to Indian band	1
I thought I was going to work for the Government, not for the Bands	1
National School of Dental Therapy and the Government don't understand the social conditions we work in and the stress that is involved	1
Opportunities for mobility	1
Mobility	1
Challenge and availability to increase learning	1
Always tied to the School for evaluation	1
Never feel at times like you have graduated...always someone looking over your shoulder	1
Expected moral support from RDO	1
Expected moral support from other therapists	1
Poor lines of communication	1
School interference and hindrance	1

APPENDIX F

FUTURE JOB CHANGE

How likely is it that you will be working as a dental therapist in Indian or northern communities in two years time?

Response	N	%
Very likely	30	48
Quite likely	14	23
Not very likely	12	19
Not at all likely	6	10
Total	62	100

Factors affecting responses, where:

Very likely + quite likely = 71% **Likely**
Not very likely + not at all likely = 29% **Not Likely**

Likely to Remain

Three most frequently mentioned factors:

Job security

Location of the job

Salary level

Other reasons:

Not qualified to work in another profession

If not working as a dental therapist I would be pursuing studies to become a dentist

All outlying communities are our responsibility

Enjoy working with children

Not likely to Remain

Three most frequently mentioned factors:

Probability of transfer/ pursue further education

Job security/ location of the job

Other reasons:

No advancement

Burnout

No chance for advancement

The social conditions in which we work
Too much negativity about about the program's future

No recognition by professional groups that the job we do is of value

Likely to Remain

Currently working towards a degree which will open other career opportunities should dental therapy in Canada's Indian and northern communities not survive the probable transfer in a satisfactory manner.

Can't afford to quit

Need the job to earn a living

I will continue to work only if dental therapy remains with Medical Services Branch

If my own Band has control of health care, I will be able to work in my own community.

The type of work (socially useful)

Because of necessity

I enjoy what I am doing

Satellite clinic

Not Likely to Remain

Husband wants to work full-time and be closer to his family

Main reason is the location of my parents. Receive annual requests to "come home"; otherwise, I would probably stay for a few years more.

Do not feel at ease with yearly evaluation. Do not feel secure due to productivity as I do a lot of prevention.

Dead-end career - no future, no opportunities for further skill development, no jobs available in other regions (in particularly southern locations.

APPENDIX G

JOB SATISFACTION

THE BEST ASPECTS OF YOUR JOB

What do you consider the best aspects of your job? List in order of importance.

First	Second	Third
Prevention and promotion	Routine resins and sealants	Filling amalgam and extractions
Working with people to improve quality of life	Working in school settings	Seeing immediate results
Salary	Location	Security
Independence-autonomy on most aspects of the job	No after hours work (i.e. on call)	
Wide range of tasks	Independence in scheduling and performing work	Satisfaction in knowing I provide a very useful function
Being able to work independently and providing a useful service	Enjoy the patients	Enjoy doing dentistry
Flexibility and responsibility in work environment	Pleasant co-workers	Good support from Zone Dental Officer
Seeing significant improvements in dental health	Independence in administering the program	Being able to focus on dental improvements in the community
Level of responsibility	Variety in work and travel	
Salary	Working with school children	Helping people to learn to care about themselves
Working for Medical Services Branch	Pay and benefits	Working in the dental field

First	Second	Third
Being able to work with native people	Working semi-independently in own clinic	Salary
Variety in work	High level of responsibility	
Variety in work	High level of responsibility	Salary
Pay and Benefits	Usefulness to society	Challenge (adventure)
I enjoy dentistry	People contact	Flexibility with the job
Establishing a prevention program in school	Establishing a good rapport teachers and students	Being a role model in native communities
The location (reservation)	Responsibility	Independence
Location of job (on reserves and in schools)	Independence - work alone	
Salary	Location	Type of work
Preventive health education	Contact with the public	Travel involved in the job
Variety in work	Changes in duties and increase in responsibilities	Working with Zone toward a common goal
Responsibility independence	The people I work for are excellent	Constant challenge, results are fast
Variety of duties	Located close to city	Salary
Direct contact with patients	Good cooperation from school staff and MSB nurses	The acceptance of local dentists who understand the concept of Dental Therapy

First	Second	Third
Working with children	Preventive lectures	Working independently as well as successfully
Teaching people healthy habits	The location and the people I work with	Salary level
Community acceptance	Children overall behaviour	Location
Providing an essential service to native people	Variety of duties performed	Pay
Doing a socially useful job	Job security	Geographical location
Security	Hours of work	Pay and benefits
Working with school children	Providing a useful and needed service	Immediate job satisfaction
Pay	Hours of work	Working with kids
Dealing with children	Performing a valuable service	Pay cheque and my holidays
Offering dental service to people in remote and isolated places	Education of children	
Working with children	Work in same clinic throughout the year	Good working hours
Independence	Salary	Pleasant working conditions
The kids are great, no problem	Teachers, nurses, and whole community are supportive	Travel to other communities
Can be very rewarding	High degree of independence	Contact with people, relationship in community

First	Second	Third
Patient relationships (students are excellent)	Working with the CHR, community involvement	
Bringing patients to better health	Being right in the school with the kids	Being trusted by the children and parents
The relationship between children, school, and community	Quality of work that's being done	Career stability
Providing a required service for children	Flexible time schedule	Moderate level of independence and responsibility
Educator	Provider	Resource person for dental information
Independence	Supervisor	Location
Satisfaction in knowing people are being relieved of their dental pain	Satisfaction in knowing teeth are being saved	Type of work
The people I deal with	The people I work for (supervisor)	People's appreciation and know my work is important
School kids	Job duties	Location
Working with school kids	Patients happy and interested when dental work is complete	Helpful co-workers
Type of work	Classroom education	Dealing with people as individuals or groups
Independence	Helpful community	

First	Second	Third
The education I'm giving the community concerning dental health	Working with kids	
Working with preschoolers and their parents	When I get recognition and appreciation from parents	Making presentations at day cares, play schools
The opportunity to make a positive contribution to community dental health	High level of responsibility	Personal situation of doing a good job
Helping the people		
Responsibilities of the job	Our pay	Working in the school system
Dental skills	Improving oral health in the community	Working on children
People I work with (school children)	Responsibilities type of work	Independence
Location	Housing benefits	Hours of work

APPENDIX H

JOB SATISFACTION

THE WORST ASPECTS OF YOUR JOB

What do you consider the worst aspects of your job? List in order of importance.

First	Second	Third
Isolation from other dental therapists	Language barrier with young children	
No advancement	Not recognized or respected for the work we do	NSDT continues to treat us as students
School system my own kids have to be in (behind other curricula)	No dental supervisor in the region	Working on hard to handle patients
Not enough trips our of the community	Holiday pay	My pay (compared to community employees with less education
Language barrier	People not knowing the stress and pressure of my job	People not appreciating my work
Isolation	Only one vacation travel assistance per year	Only resident dental professional
Little recognition by GNWT collective agreement	Being limited to work only on school kids	Evaluations done by NSDT
Community not recognizing dental problems	Lack of support from parents	Lack of responsibility
Isolation	Social problems of the community	Lack of regional "team" effort
My house	Salary	More vacation leave

First	Second	Third
Being isolated from my home reserve	Not having a dental assistant	Dealing with difficult patients
Pay and benefits	Clinic not being located in school	
Lack of input into dental health care in the region	Lack of opportunities for further education	Lack of recognition from dental profession
No job security		
Geographical location	Frustrations when I can't see results	Adult referrals which usually never get done
No promotion no advancement	Not enough upgrading courses	
Bureaucratic bungling	Moving heavy equipment	Paper work
MSB staff who don't understand our job	No job advancement available	Bureaucrats who think paper work is more important than patients
Travel and moving equipment	Attitude of public about dental work	
No continuing education for advancement	Dealing with government staff who do not understand our job	Sometimes very stressful working conditions
Loneliness	boredom of dead-end job	Some program policies
Working alone	Poor clinic space	Poor career prospects
My supervisor	Very poor attendance in school	Teachers' cooperation

First	Second	Third
No recognition from other dental professionals	Not enough work-shops (training)	Dealing with very young children
Regional Dental Officer not supportive	Having two clinics but one set of equipment	Being evaluated on a yearly basis by NSDT
Reporting to two directors who do not have the same goals/objectives	Not being able to treat the children without DIAND Numbers	All the DIAND numbers and paper work
Small clinic	Lack of "thank-fulness" from people	Lack of training courses
Stress/burnout occasionally	Lack of profes-sional support to deal with issue, problems	Travelling to and from work
Lack of a career ladder	Not enough dental therapists in order to have a good dental program	Insecurity due to transfer
Working alone (being isolated in the field)	No opportunity for career development	No recognition for dental therapy program at national level or post secondary institutions
Poor job security	Federal Govnm't only employer	No opportunity for further education
The amount of travelling each day (esp. in winter)	The amount of paper work	
No career ladder	Restricted number of places to work	Difficulty in working on pre-schoolers

First	Second	Third
Not recognized by CDA or the provincial dental associations	No job security	
No recognition by CDA or provincial dental assns.	Living in northern communities	
Politics of transfer to Band control	Being placed under Band Control	No opportunity for advancement
No recognition in the dental field	Social conditions in which we work	Health risk and becoming under band control
Job security: constant talk of further limiting the program	Morale: no effective lobbying voice	Restricted: only to native people in the provinces
Lack of client appreciation	down time or loss of productivity	isolation
Native transfer of dental therapist	Racial discrimination	Land claims backlash
Back fatigue	Lack of recognition from dental associations	Restriction of treatment (ie, space maintainer, treatment exams)
Poor prospect for further education in any field	Dental Therapy not recognized by CDA	Dental therapy not keeping abreast of new techniques
Moving equipment from village to village by air		
Distance from family	Difficulty in motivating some clients and the CHR	Difficulties in transportation and working conditions at times

First	Second	Third
Travelling on poor roads and weather conditions	Having to lift heavy equipment	Limitation of where and for whom we can work
People do not realize the importance of dental health		
Lack of parental concern	Working without an assistant	Packing and moving heavy objects
Not able to continue when pulp exposure and have to refer on anterior	Not having a dental clinic	Not enough work to keep me busy
Being continually tied to NSDT	Increasing amount of paper work cutting into clinic time	Not having an assistant
Dead-end career	Remote geographical locations	No opportunities for further skill development
Working in the summer when things are slow	No appreciation from parents	Parents taking no responsibility for their children's teeth
Getting consents		
Location		
Difficulty in changing attitudes re dental health	Cleaning and sterilizing between patients	At times the isolation
Lack of support from Reg. Dental Officer	Future of dental therapy	Extra work requested by Reg. Dental Officer
No support from upper management		

APPENDIX I

ASSESSMENT AND EVALUATION OF DENTAL TREATMENT IN THE BAFFIN REGION

Assessment and Evaluation of Dental Treatment in the Baffin Region
by P. Ralph Crawford, D.M.D. and Bradley W. Holmes, D.D.S.

	Dental Therapists							Dentists						
		Superior		Satis-factory		Failed			Superior		Satis-factory		Failed	
Type of Restoration	Total No.	N	(%)	N	(%)	N	(%)	Total No.	N	(%)	N	(%)	N	(%)
One Surface Amalgam	537	153	28.5	379	70.6	5	0.93	295	24	8.1	257	87.1	14	4.7
Two Surface Amalgam	231	88	38.1	140	60.6	3	1.3	198	18	9.1	158	79.8	22	11.1
Three Surface Amalgam	71	37	52.1	34	47.9	0	0.0	93	8	8.6	74	79.6	11	11.8
Four Surface Amalgam	14	8	57.1	6	42.9	0	0.0	20	4	20.0	15	75.5	1	5.0
Composite 1 Surfaces	73	3	4.2	56	76.6	14	19.2	196	10	5.1	146	74.5	40	20.4
Composite 2 Surfaces	16	3	18.8	11	68.7	2	12.5	55	4	7.3	43	78.2	8	14.5
Composite 3 Surfaces	2	0	0.0	1	50.0	1	50.0	13	3	23.0	8	61.5	2	15.4
Stainless Steel Crown	39	20	51.3	19	48.7	0	0.0	7	0	0.0	5	71.4	2	28.6
Totals	983	312	31.8	646	65.7	25	2.5	877	71	8.1	706	80.5	100	11.4

APPENDIX J

RATING SYSTEM FOR QUALITY OF CARE

Table 1

Rating System for Quality Evaluation

SATISFACTORY	(R) ROMEO	— Indicates clinical quality and/or professional performance rated in the range of excellence.
	(S) SIERRA	— Indicates clinical quality and/or professional performance rated in the range of acceptability.
NOT ACCEPTABLE	(T) TANGO	— Indicates clinical quality and/or professional performance which SHOULD be repeated, replaced, repaired or corrected for preventive reasons and is likely to cause future damage to the patient's general or dental health, or to individual components of the patient's masticatory system.
	(V) VICTOR	— Indicates clinical quality and/or professional performance that MUST be repeated, replaced and/or immediately treated because damage is now occuring or because serious inadequacies exist.

Table 2

Rating System for Restorations

Rating	Operational Explanation
Satisfactory	
Range of Excellence Code: R Call: Romeo	The restoration is of satisfactory quality and is expected to protect the tooth and the surrounding tissues.
OR	OR
Range of Acceptability Code: S Call: Sierra	The restoration is of acceptable quality, but exhibits one or more features which deviate from ideal conditions.
Not Acceptable	
Replace or Correct for Prevention Code: T Call: Tango	The restoration is not of acceptable quality. Future damage to the tooth and/or its surrounding tissues is likely to occur.
OR	OR
Replace Statim (Immediately) Code: V Call Victor	The restoration is not of acceptable quality. Damage to the tooth and/or its surrounding tissues is now occurring.

Table 3

Quality Evaluation Criteria and Abbreviations

Rating	Code	Surface and Color
Satisfactory		
R Romeo		Surface of restoration is smooth. No alteration of adjacent tissue.
		No mismatch in color shade and/or translucency between restoration and adjacent tooth structure.*
S Sierra	SRO	Surface of restoration is slightly rough or pitted, can be refinished.
	SMM	Mismatch between restoration and tooth structure within the normal range of tooth color, shade, and/or translucency.*
Not Acceptable		
T Tango	TPIT	Surface deeply pitted; irregular grooves (not related to anatomy), cannot be refinished.
	TMM	Mismatch between restoration and tooth structure outside the normal range of tooth color, shade, and/or translucency.*
V Victor	VSF	Surface is fractured or flaking. Esthetically displeasing color, shade and/or translucency.*
	VFK	
	VUN	

Rating	Code	Anatomic Form
Satisfactory		
R Romeo		Restoration's contour is continuous with existing anatomical form restores contours, cusps planes grooves marginal ridges and functional contact points
S Sierra	SUCO	Restoration is slightly under-contoured
	SOC	Occlusal contour not continuous with that of cusps and planes, OR
	SOH	Occlusal height reduced locally (not in toto), OR
	SMR	Marginal ridges slightly under-contoured (low) OR
	SCO	Contact slightly open (may be self-correcting), OR
	SFA	Facial flattening, OR
	SLG	Lingual flattening, OR
	SPX	Interproximal cervical area slightly under-contoured, OR
	SOCO	Restoration is slightly over-contoured, but excess material could be removed
Not Acceptable		
T Tango	TUCO	Restoration is under-contoured
	TDE or TDB	Dentin or base is exposed OR
	TOC	Occlusion is affected OR
	TCO	Contact is faulty (self-correction is unlikely), OR
	TPX	Interproximal cervical area under-contoured tissue damage likely
	TOCO	Restoration is over-contoured
		Contour cannot be adjusted properly OR
	TOV	There is marginal over-hang
V Victor	VMIS	Restoration is missing OR
	VTO	Traumatic occlusion OR
	VPN	Restoration causes pain in tooth or adjacent tissue

Rating	Code	Margin Integrity
Satisfactory		
R Romeo		No visible evidence of ditching along the margin.
		No discoloration on the margin between the restoration and tooth structure.*
S Sierra	SCR	Visible evidence of ditching along the margin, not extending to the DE junction
	SDIS	Discoloration on the margin between the restoration and the tooth structure.*
Not Acceptable		
T Tango	TMD or TMB	Dentin or base is exposed along the margin.
	TPEN	Discoloration has penetrated along the margin of the restorative material in a pulpal direction.*
V Victor	VMO	Restoration is mobile, OR
	VFR	Fractured, OR
	VCAR	Caries contiguous with the margin of restoration, OR
	VTF	Tooth structure fractured.

* Criteria apply to anterior restorations.

Table 4

TREATMENT PLAN **TREATMENT PLAN**

Quality Evaluation Rating System			Quality Evaluation Criteria and Abbreviations			
	Rating	Operational Explanation	Code	Documentation	Code	Sequence
SATISFACTORY	R Range of Excellence Romeo Code: R Call: Romeo	A satisfactory treatment plan has been developed and recorded.		The treatment plan and procedures are written systematically in the patient's record before treatment is started Where only operative procedures such as restorations are planned, symbolic charting will suffice as a treatment plan (Refer to General Guidelines)		The treatment plan is written and follows a logical sequence (Refer to General Guidelines.)
	S Range of Acceptability Sierra Code: S Call: Sierra	The treatment plan which has been developed and recorded is acceptable even though one or more aspects of the diagnosis were not thoroughly considered.	STP	The treatment plan is recorded sketchily, and/or the restorative treatment procedures are not planned	SSQ	The treatment plan lacks systematic sequence; but either the sequence is not important or it is obvious from the charting.
NOT ACCEPTABLE	T Not Acceptable Rationale Questionable Tango Code: T Call: Tango	The treatment plan is not acceptable, or the sequence of treatment is inappropriate, but the deficiencies do not appear to jeopardize the dental or general health of the patient.	TTP	There is no written plan of treatment of routine uncomplicated case	TSQ	The sequence of treatment may delay treatment of existing conditions that are potentially harmful
	V Not Acceptable Inadequate Victor Code: V Call: Victor	The treatment plan is not acceptable. Treatment of harmful or dangerous conditions has not been included or the sequence of treatment is inappropriate.	VTP	There is no written plan of treatment of complex cases	VPRI	Priority has not been given to the treatment of serious conditions that are harmful or dangerous

APPENDIX K

NATIONAL SCHOOL OF DENTAL THERAPY

CURRICULUM SUMMARY

NATIONAL SCHOOL OF DENTAL THERAPY

2-YEAR CURRICULUM SUMMARY (2,850 Hours)

COURSES AND CLINICS	PRE-PATIENT SCHEDULE (within Year I)			PATIENT CARE	MISC. Spare Travel etc.
	Lecture	Clinic	Sub Total		
DIAGNOSTIC DENTISTRY					
Medical Evaluation	50	2			
Dental Evaluation					
Exam., Diag., Treat.Plan., Case Pres'n	85	5			
Dental Radiography	20	20			
			182		
OPERATIVE DENTISTRY					
Restorative Dentistry (Prepatient - incl. Dental Morphology, Materials)	70	755			
Dental Surgery and Local Anaesthesia	50	20			
			895		
PROGRAMME SUPPORT					
Equipment Maintenance and Repair	25	70			
Infection Control	10	2			
Administration	30	6			
			143		
COMMUNITY AND PREVENTIVE DENTISTRY					
Community and Preventive Dentistry I	40	10			
Clinical Periodontics	10	10			
			70		
Community and Preventi- Dentistry II					
Yr.II, A - Surveys, thern Health, Comm. Prog., Dent. P.H.				55	
Yr.II, B - Communication and Teacher Training				30	
TUTORIAL PROGRAMME (YR. I)					
Up to 125 hrs available for special remedial Tutorials. Time taken from Yr. I Restorative Dentistry Clinic.					
CLINICAL DENTISTRY WITH PATIENTS					
Patient Care, Clinic Administration, and Routine Clinical Procedures					
N.S.D.T. Clinic				1,000	
Field Clinic				230	
MISC. Breaks, Spares, Travel, Recreation					245
SUB-TOTAL HOURS:			1,290	1,315	245

GRAND TOTAL HOURS: 2,850

APPENDIX L

COST AND BENEFIT LOG SHEET

Cost and Benefit Worksheet

D.T. Code: _____

Year	Salary	+	IPA	+	Supplies	=	Costs	$ Value of Work	X	Reimb'mt Factor	=	Benefits
1984		+		+		=			X		=	
1985		+		+		=			X		=	
1986		+		+		=			X		=	
1987		+		+		=			X		=	
1988		+		+		=			X		=	
1989		+		+		=			X		=	
1990		+		+		=			X		=	

Cost of Dental Supplies for each quarter:

	1984	1985	1986	1987	1988	1989	1990
Jan. - March							
Apr. - June							
July - Sept.							
Oct. - Dec.							

APPENDIX M

DENTAL THERAPIST MONTHLY/ANNUAL WORK SUMMARY

Dental Therapist Monthly/Annual Worksheet

Dental Therapist _____ Year _____

	LOCATION	NUMBER PATIENTS	COMPLETED PTS	EXAMS: IP PLAN	EXAMS: EMERGENCY	EXAMS: RADIOGRAPHS	PREVENTION: OHI	PREVENTION: PERIO'S MIM	PREVENTION: PROPHY	PREVENTION: FLUORIDE	PREVENTION: SEALANTS	AMALGAM SURFACES: 1	AMALGAM SURFACES: 2	AMALGAM SURFACES: 3	AMALGAM SURFACES: 3+	RESINS	CROWNS	PINS	POLISHING	PULPOTOMY	OTHER TREAT	EXTRACTIONS: PRIMARY	EXTRACTIONS: PERMANENT	HOURS: CLINIC	HOURS: PUBLIC HEALTH	HOURS: OTHER	NOTES
Jan																											
Feb																											
Mar																											
Apr																											
May																											
June																											
July																											
Aug																											
Sept																											
Oct																											
Nov																											
Dec																											
	Totals:																										
	Monthly Mean:																										

APPENDIX N

RELATIVE VALUE UNITS

AND

VALUE OF DENTAL PROCEDURES

ONE RELATIVE VALUE UNIT (RVU)*

	1990	1989	1988	1987	1986	1985	1984
Newfoundland	28.00	27.00	26.00	25.00	24.00	23.00	21.30
Nova Scotia	27.00	25.00	24.00	23.00	25.00	25.00	23.50
New Brunswick	29.00	27.00	26.00	25.00	24.00	24.00	23.00
Manitoba	25.80	23.70	22.70	20.80	19.90	18.70	17.00
Saskatchewan	21.70	19.90	19.30	19.30	19.30	19.30	18.40
Alberta	30.96	29.46	27.44	26.23	25.09	23.95	23.07
British Columbia	37.50	34.70	32.40	30.80	29.30	27.80	23.20
Yukon	45.00	41.65	38.90	37.00	35.15	33.40	27.85
Northwest Terrs.	37.00	35.00	33.00	31.00	30.00	29.00	28.00

*One Relative Value Unit = One surface primary amalgam restoration.

VALUE OF DENTAL PROCEDURES*

Procedure/Code	Provinces Nfld	N.S.	N.B.	Man.	Sask	Alta	B.C.	YK	NWT
01205 Emerg. Exam	.60	1.00	.66	.78	1.06	1.00	.47	.47	1.00
02122 Radiographs[1]	.50	.39	.54	.46	.57	.61	.33	.33	.62
13211 OHI[2]	.50	.48	1.10	.59	.93	.94	.55	.55	.95
43411 Perio/15 mins	1.25	1.15	1.10	.89	1.10	1.00	.55	.55	1.00
11200 Prophylaxsis[3]	1.70	1.13	1.31	1.00	2.27	1.53	.75	.75	1.54
12101 Fluoride	.35	.44	.48	.28	.47	.47	.25	.25	.49
13401 Sealants	.55	.56	.52	.42	.56	.47	.40	.40	.47
21100 Amalgam Surf. One-Two Surf.[4]	1.44	1.45	1.27	1.44	1.53	1.29	1.17	1.17	1.30
21223 Three Surf.[5]	2.60	2.85	2.48	2.57	3.02	2.11	1.84	1.84	2.11
21224 Four plus Surf.	3.30	3.92	3.26	3.04	3.82	2.64	2.25	2.25	2.65
23100 Resins[6]	2.00	1.91	1.94	1.96	2.27	1.72	1.29	1.29	1.73
22211 Crowns	3.00	2.70	3.00	2.49	2.64	2.11	2.43	2.43	2.11
21401 No. of Pins	.43	.37	.45	.40	.50	.38	.38	.38	.38
13300 Polishing[7]	1.13	1.39	1.66	.66	1.40	1.50	.89	.89	1.50
32231 Pulpotomy	1.88	1.69	1.72	1.37	1.67	2.00	1.32	1.32	2.00
71100 Extractions	1.25	1.48	1.17	1.28	1.63	1.00	.93	.93	1.00
Other[8]	1.16	1.29	1.06	1.00	1.32	1.00	.77	.77	1.00

* Stated as a percentage of one Relative Value Unit (One-surface primary amalgam) 1990 provincial dental associations suggested fee guide for dental services.

[1] Average of one-two-three film intraoral periapical and one-two film intraoral bitewing (02111-2-3; 02141-2).

[2] Chairside Oral Hygiene Instruction

[3] Average of mixed and permanent dentition (11202 and 11203)

[4] Average of one-two surface primary and one-two surface permanent (21101; 21102; 21211; 21212)

[5] Permanent molar surfaces

[6] Average of one-two surefaces permanent (23111; 23312)

[7] Average of one-two units of time (13301; 13302)

[8] Average of:
13101 Nutrition/dietary counselling
20110 Caries/Trauma control
29100 Recementation crowns
39910 Endodontics: opening and drainage
43300 Occlusal adjustment
91100 Palliative care

APPENDIX O

BUDGET

NATIONAL SCHOOL OF DENTAL THERAPY

July 1, 1982 - June 30, 1987

NATIONAL SCHOOL OF DENTAL THERAPY

Acutal Expenditures 1982 - 1987

	Salaries	O & M	Capital	Total
July 1, 1982 - June 30, 1983	514,250	182,654	107,827	804,731
July 1, 1983 - June 30, 1984	570,251	399,664	57,449	1,027,364
July 1, 1984 - June 30, 1985	613,791	551,816	150,465	1,316,072
July 1, 1985 - June 30, 1986	660,904	499,674	162,473	1,323,051
July 1, 1986 - June 30, 1987	681,674	504,674	198,975	1,385,410

APPENDIX P

NATIONAL SCHOOL OF DENTAL THERAPY

ESTIMATED STAFF TIME DISTRIBUTION

ESTIMATED STAFF TIME DISTRIBUTION IN PERCENTAGES - TRAINING AND OTHER (NON-TRAINING) RESPONSIBILITIES COMPARED

Responsibilities at National School of Dental Therapy	DENTISTS														DENTAL THERAPISTS						TECHNICIAN		OFFICE AVE.	
	DAVEY		SPINK		JUTAI		SCHNELL		GERSHMAN		TORBERT		J-R 1/2 time		BEVINGTON		KRAUSS		CAMP		DA SILVA		3 Staff	
	Train	Other	Train	Other	Train	Other	Train	Other	Train	Other	Train	Other	Train	Other	Train	Other	Train	Other	Train	Other	Train	Other	Train	Other
Clinical Instruction at NSDT and Teaching Field Clinics	6		27		25		32		35	3	35		53		40		40		30		5			
Classroom Teaching, Preparation, Exams	4		22		14		20		25		30		11				2		5		14			
Duty Travel; NSDT Training, Evaluation & Supervision of Grads.	8	16		16		20		18		14		16		24		8		10		8		7		
Administration, NSDT M.I.S., Surveys, D.T. Services, Stud.Records	40	26	11	12	17	17	18		5				2						2	19		29		
Extra Activities, Orientation Dentists, Nurses, Recruitment.					4	3		2		2		2												
Meetings, Projects, Continuing Education			10	2			10		8	8	6	10	5	5				2				5		
Stores, Inventory, Shipping, Purchasing															8	40	16	30	6	30				
Office Management, Secretarial, Student Services, Reception																							68	32
Equipment Servicing, Assembling															2	2					4	36		
Percentage Totals %	58	42	70	30	60	40	80	20	73	27	71	29	71	29	50	50	58	42	43	57	23	77	68	32

NOTE: 1. Based on estimates and averages from current timetable. In many circumstances, it is difficult to separate activities solely related to training from other (non-training) activities or programmes.
2. Percentages less than 2% not considered significant and absorbed into related activities.

SUMMARY: 1. % time all staff devote to the activity of training dental therapists - 61%
2. % time all staff devote to other activities beyond training responsibilities - 39%

Nov/'90

APPENDIX Q

CONSUMER PRICE INDEX

1980 - 1990

Consumer Price Index
Annual Inflation Rate

Year	Inflation Rate
1980	10.2
1981	12.5
1982	10.8
1983	5.8
1984	4.4
1985	4.0
1986	4.1
1987	4.4
1988	4.0
1989	5.0
1990	4.8

Source: Statistics Canada

APPENDIX R

QUALITY OF CARE RATIOS

RATIO OF RESTORATIONS TO EXTRACTIONS PERFORMED BY DENTAL THERAPISTS, 1978-87

Year	Alta	Atlc	Man	Pac	Sask	NWT	Yukon
1978	6.22	4.45	---	18.95	---	2.38	19.77
1979	9.37	5.63	3.37	15.17	---	5.21	28.20
1980	7.32	6.98	3.40	13.76	---	4.85	26.65
1981	5.53	7.29	3.57	13.54	6.69	4.70	21.00
1982	9.47	10.00	3.42	15.64	10.01	5.05	19.61
1983	13.07	9.23	4.72	20.06	9.37	7.21	24.20
1984	12.18	9.35	4.35	20.66	14.04	8.40	20.49
1985	12.78	11.69	4.06	23.12	15.26	7.29	25.41
1986	19.33	13.07	4.66	20.10	19.21	7.66	24.12
1987	19.37	13.36	5.81	14.55	14.55	8.04	22.48

Source: Dental Therapists' Annual Productivity Summaries

RATIO OF RESTORATIONS TO PREVENTIVE WORK PERFORMED BY DENTAL THERAPISTS, 1978-87

Year	Alta	Atlc	Man	Pac	Sask	NWT	Yukon
1978	3.71	2.58	---	10.59	---	4.0	1.83
1979	2.56	2.56	18.06	3.97	---	3.62	1.58
1980	2.56	2.01	5.18	4.43	---	3.13	1.50
1981	1.47	2.82	4.42	4.60	2.81	3.01	1.54
1982	1.89	1.61	5.06	3.93	2.23	3.42	1.44
1983	2.18	1.42	4.05	3.75	1.54	3.18	.90
1984	1.75	1.26	3.08	3.11	1.16	2.19	.83
1985	1.32	1.05	1.52	2.01	1.19	1.30	1.06
1986	.78	1.06	1.47	1.66	.75	1.19	.98
1987	.55	.93	1.24	1.52	1.52	.98	.79

Source: Dental Therapists' Annual Productivity Summaries